The Dock and Harbour Authority

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Editorial Comments

"Silver Jubilee."

This issue is the 300th since the commencement of the Journal and marks the completion of 25 years of publication. Using a term which has lately come into vogue, it signalises the Silver Jubilee of the undertaking and is, accordingly, a matter for cheerful, if restrained, congratulation. For five-and-twenty years the Journal has appeared regularly without a break, notwithstanding the vicissitudes of international affairs and the vagaries of home politics. It has passed successfully through a national strike and a financial crisis, and now it is emerging from the throes of the greatest war ever waged in the history of the world.

True, it has not escaped altogether unscathed. The format of the paper and the number of its pages have had to undergo drastic curtailment on account of the exigencies of war-time paper shortage, but this experience has been shared in common with all contemporary journals. A greater trial has been the censorship which has laid a heavy hand of prohibition on much news and current information relating to ports and harbours during six long years of war. We have had to bow to the necessity of preserving silence on many matters which, if published, would have been helpful to the enemy and detrimental to the interests of the Allied forces. Happily, this period of repression is now over and as soon as paper supplies and printing service become more plentiful, our readers may look forward to a resumption in volume to pre-war standards and a greater output of useful news in the field covered by the Journal. We propose to retain the present format as being more convenient than the old.

It is interesting to look back on the early days of the Journal's history and readers will find on a subsequent page some reminiscential notes on the subject. We venture to express the hope that those who have followed us so far with their kindly encouragement and support will continue to sustain the Journal in its endeavour to provide port officials and users with information which will be of service to them in the discharge of their manifold and onerous duties and responsibilities.

How far the Journal has succeeded and is succeeding in this laudable ambition must be left to our readers to decide.

A Great Durham Port.

Among a number of notable ports on the North-East Coast of [illegible]try, Sunderland stands out in special prominence as not only a busy harbour with much coastal and overseas trade, but also as a great shipbuilding centre where vessels of all sizes and tonnage are built to sail the seven seas. With full justification Mr. A. H. J. Bown, the general manager and clerk to the River Wear Commissioners, who contributes the article on the port in this month's issue, lays stress on this fact and claims that Sunderland is the largest shipbuilding town in the world, instancing that, in 1942, the Wear shipyards turned out in that year a greater tonnage than any other shipbuilding district. In addition to this excellent record, the port has enjoyed in the past a very considerable trade in coal; it has an important fishery industry and it now caters plentifully in supplies of oil to oil-burning craft.

Mr. Bown sketches the ancient history of the place, outlining its progress from Saxon days, when Monkwearmouth, the Northern part of the present town, was the nucleus for the large community which has spread along both banks of the Wear. During Tudor times a great impetus was derived from the export of coal, principally to London, though supplies were also sent to Holland, France and other parts of Continental Europe. It is of interest to mention that the local collieries are remarkable as including one of the deepest in the world with a depth of 381 fathoms.

Our readers will find much to engage their attention in the important programme of improvement works envisaged at the port. Approximating in estimated cost to four million pounds, they indicate a commendable degree of foresight and enterprise on the part of the Commissioners, who, it is to be hoped, will receive the desired financial aid of the Government in giving effect to their development plans.

The Trades Union Congress Transport Scheme.

Since the acecssion to power of the Labour Party and the formation of a Socialist Government, there has been no long period of waiting for the insistent demand, foreseen before the election, for the immediate nationalisation of all the principal activities of the nation, financial, industrial, commercial and transportational. Indeed, at the present time, nationalisation would appear to be a wonderful talisman, rivalling "that blessed word Mesopotamia" in its assumed universal beneficence. It is credited with the power to remedy all operating difficulties and defects in the existing order of things, these being attributed to a "wicked capitalism," the term thoughtlessly applied in many quarters to private enterprise.

Editorial Comments—continued

The General Council of Trades Union Congress, held at Blackpool on September 10th and following days, has put forward a comprehensive political programme for the amalgamation in a single system of all British transport services: rail, road, canals, airways, coastwise shipping and ports and docks. It is a portentous list, in which the attention of our readers will be mainly concentrated on the last-named items. From the Report presented to the Congress and published in the daily press, they will have learned that a post-war port organisation is proposed which will consist in the unification of all ports in accordance with the type exemplified by the Port of London Authority, with an obligation on shippers and merchants to use the particular port which can most efficiently provide the required service, apparently in accordance with overriding direction.

For the enforcement of this obligation without regard to "uneconomic rate-cutting," British ports are to be controlled by a Port and Docks Board specially created "to co-ordinate port activities on a regional basis, to give effective supervision and to secure a more standarised practice": in other words to teach port authorities their business and to see that they do it according to Government dictation.

Details of the scheme have not yet been divulged. When they emerge from their present obscurity and are published, there will be an opportunity for more critical examination of the proposals, but, in the meantime, we would express our conviction that the advocates of the scheme, carried away by the glamour of their excellent intentions, have scarcely made themselves adequately conversant with the immense difficulties to be overcome and the enormous risks to be undertaken in the sudden and violent overthrow of the present system of trade and transport in an endeavour to establish a Utopian alternative.

Utopia, Sir Thomas More's realm of perfection, is, no doubt, an admirable ideal, but in mundane affairs, extremely difficult, if not impossible, of attainment. And we would call our readers' attention to the considered judgment, *after the election*, of the President of the Board of Trade. "I would emphasise," said Sir Stafford Cripps at the Blackpool meeting, "that we are not on the eve of entering a Utopia, where all is ease and prosperity. Whatever else the election of a Labour Government has accomplished, it has not brought Utopia to our doors."

To this candid admission we would merely add a reference to an old-world fable which contains an impressive moral. Æsop relates the story of a foolish dog who, crossing the bridge over a stream, dropped the real bone he was carrying for the fancied superiority of its reflection in the water.

Finally, and inevitably in this connection, the question obtrudes itself: What has become of the scheme for National Post-War Port Re-organisation prepared with so much thought and deliberation by the Special Committee of the Dock and Harbour Authorities Association, approved at the General Meeting of the Association in February last and laid before the Ministry of War Transport, who had invited a statement of their views. Many of our readers will be wondering, as we do ourselves, about the fate of these proposals, concerning which no information so far has been vouchsafed by the Ministry. Have they been scrapped or pigeonholed? The Report on the scheme, with our comments thereon, was published in the issue of this Journal for April.

Thames Lighterage.

As is pointed out by Mr. F. C. Bowen in the article on Thames Lighters which appears in this issue, few people realise the scope and extent of the lighterage industry at the Port of London. London is essentially what is called a "barge port," that is to say by far the greater bulk of its cargoes is handled ovedside, by loading from, or unloading into, barges which lie alongside the ships, either in the docks or at riverside wharves. In fact, one of the most cherished privileges of the London watermen is that of free entry into the docks of the Port Authority for the purpose of receiving and transferring goods.

Barge traffic is not by any means so essential a feature at other ports, though there are some notable instances of its importance. New York has a large fleet of lighters on account of the insular position of Manhattan. Rotterdam naturally relies for a large proportion of its river traffic on the enormous Rhine barges which dwarf any to be found on the Thames. Hamburg, too, before its devastation during the war, used to do a substantial part of conveyance to and from warehouses in the city by means of canal and waterway craft. But Liverpool, Manchester, Southampton, Hull and many other ports are served almost entirely by rail connections which do not call for any great use of barges. At any rate, it may be said that lighterage is an industry specially inherent in the Port of London and there would be a strange metamorphosis in the lower reaches of the Thames if the varied fleets of sailing, motor and steam-propelled and dumb barges disappeared from the scene.

The Noise of Waves.

An interesting and strikingly suggestive article on Wave Turbulence, from the pen of Dr. Herbert Chatley, appears in this issue. It deals with a matter of every-day experience which, however, has met with little attention—and practically no investigation—from maritime engineers. To dwellers on the seaboard of a country the sound of waves breaking on the beach is so common that it excites little interest, unless accompanied by the devastating effect of some powerful wave stroke, in which case the predominating impression is force apart from noise. Yet the noise is not without its significance: it is a form of dissipation of energy and an indication of wasted effort on the part of Nature.

Indeed, Nature is very prodigal of her products. "Of fifty seeds she often brings but one to bear." Readers will perhaps recall from juvenile days the episode of the Walrus and the Carpenter recorded in Alice's Adventures Through the Looking-glass:

> "The Walrus and the Carpenter
> Were walking hand in hand:
> They wept like anything to see
> Such quantities of sand."

Though scarcely a subject for lachrymation, there is certainly food for much philosophical reflection in the vast extent of the shores of the world with their illimitable stores of apparently useless, and often-times to the harbour engineer very obnoxious, beach material. Similarly, the ceaseless action, hour by hour, of the waves, however melodious and pleasing to the poetical observer and nature-lover, represents, none the less, an appreciable amount of kinetic energy lost to practical purpose and dissipated in forms of heat and noise. Cognate to wave action, tidal power is another practically untapped source of energy, which offers a vast field for development. Finally, there are the stupendous possibilities of atomic nuclear fission, revealed in the most startling announcement of modern times to an awe-struck, not to say dismayed, world. In short, boundless stores of latent energy exist in nature awaiting exploitation for purposes which, it is devoutly to be hoped, will be utilitarian and not merely destructive.

Russian Internal Waterway Development.

With characteristic energy, the Soviet Government, immediately following the headlong retreat of the invading Germans, set about repairing the damage incurred during the disastrous years of enemy occupation. Among the measures taken, the Dnieper Dam and its power station, the largest installations of its kind in the world, is now being replaced by a new power station of even greater potentiality—at Rybinsk, 150 miles north of Moscow. Not only will the new dam be a means of providing power for electric generation, but it will open up the whole of the Upper Volga river to navigation. The work was actually commenced in 1937, but suffered interruption during the war and was resumed in 1944. The portion of the work already completed has enabled large tankers from the Volga to reach Moscow and to link up the Russian capital with the oil-producing regions round Baku and in Iran.

Opening of Cape Town New Graving Dock.

The large new engraving dock at Cape Town very nearly, if not quite the largest, in the world, was officially opened on September 18th by Chief Justice N. J. de Wet, chief administrative officer of the Union of South Africa.

The Port of Sunderland

A Great Durham Port

By A. H. BOWN, A.C.I.S., M.Inst.T.
General Manager and Clerk, River Wear Commission.

Early History

THE first authentic evidence of the Port and Borough of Sunderland, at the mouth of the River Wear, as a place of maritime commerce is the Charter granted in 1154 by Bishop Pudsey to "Weremouth" or Sunderland. Amongst other things the Charter provided that disputes betwixt burgesses and foreign merchants should be determined within

Sir FRANK NICHOLSON, C.B.E., J.P.
Chairman of the River Wear Commissioners.

three tides, and all merchandise brought by sea should be landed before sale, except salt and herrings which could be sold on board.

In 1634, Bishop Morton, desirous of encouraging the trade of the Borough, granted a Charter of Incorporation to the burgesses and inhabitants by the title of "Mayor, Aldermen and Commonalty of the Borough of Sunderland." The preamble of the Charter stated that "Sunderland is, and time out of mind hath been, an ancient borough, known by the name of the New Borough of Weremouth, containing in itself a certain port where, from which, in which, and through which, very many ships and other vessels used by mariners, as well within the kingdom of England as from foreign parts come and ply, introducing and importing merchandise, goods, and other saleable articles, and exporting from the said port sea-coals, grindstones, rubstones and whetstones and other merchandise."

In 1669, a petition was presented to Charles II setting forth "that the harbour and river being very commodiously situate for the shipping of vast quantities of sea-coles plentifully gotten and wrought there, for supply of all our subjects of our realm of England, who can fetch the same, as also of foreign parts, is of late so much gorged, stopped up, and choked; and by the many shoals, sandbeds and much breach and rubbish daily increasing in the same, is almost rendered unnavigable."

Complying with the request of the petition, His Majesty granted Letters Patent to Edward Andrew, Esq., empowering him to build a pier at Sunderland, to erect lighthouses, and to forbid the casting of ballast at sea, within certain limits. He was also directed to cleanse the harbour from shoals and sandbeds, and powers were granted to him to levy contributions for these purposes by a tonnage duty on ships frequenting the port. Little, if anything, however, appears to have been done under these powers.

Port Authority Constituted

The Port Authority was first constituted under the title of "Commissioners of the River Wear" by an Act of Parliament passed in 1717. The Act appointed Commissioners for 21 years, who were charged with the conservancy of the harbour and were empowered to raise money, by a tonnage duty on vessels entering the port, for the purpose of making the river navigable to Newbridge in the Parish of Chester-le-Street and building a pier at its mouth. Several successive Acts were passed continuing these powers.

Mr. A. H. J. BOWN, A.C.I.S., M.Inst.T.,
General Manager & Clerk, River Wear
Commissioners & General Manager Sunderland
Corporation Quay.

Although the Commissioners appear to have applied themselves to their duties and completed the first pier on the South side of the river in 1726, in 1755, it was stated that the channel at the mouth of the harbour was so very narrow and shoal that ships drawing only 6 or 7-ft. of water were often prevented from getting out to

Port of Sunderland—continued

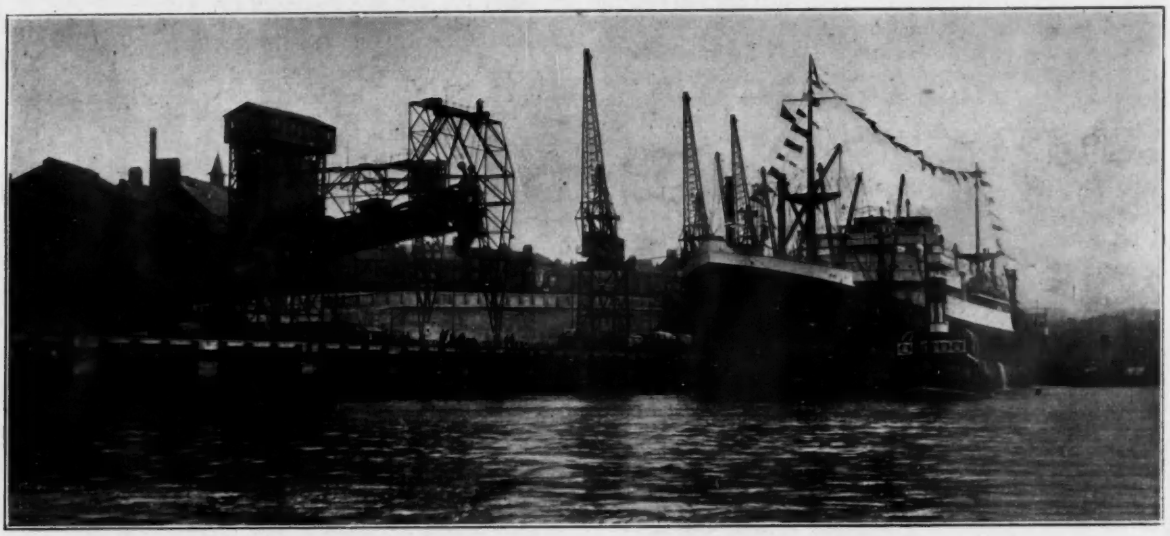
sea, and withal was so very crooked and oblique that the wind which served for conducting ships out of the harbour was unfavourable for conveying them away to the southward where almost the whole trade lay, and that the wind which was fair to bring them from thence was as unfavourable for them entering the harbour.

By the end of the 18th century, however, considerable improvement had been effected, including the formation of a regular channel, which necessitated cutting 4½-ft. through a rock extending 500-ft. in length and 180-ft. in breadth, the extension and alteration of the direction of the South Pier, and the construction of a pier on the North side of the river.

By provisions of the "Wear Navigation and Sunderland Dock Act, 1859," the Commissioners were incorporated under the title of "River Wear Commissioners," and the undertaking of the Sunderland Dock Company was vested in them.

The Commissioners had to spend a considerable amount of money in order properly to equip the docks. To meet the needs of the growing trade and the increasing size of ships, they built another dock, called the Hendon Dock, to the South of and connected by gates to the extension of the original South Dock, the work being completed in 1868. In 1865 a second public graving dock was built.

The South Docks have been extended and improved from time



Sunderland Corporation Quay: Royal Mail Liner loading binder twine for Canada.

Dock Construction

An agitation had existed for many years for the construction of wet docks in which vessels could be more safely accommodated, and scheme after scheme was propounded from about 1794. Ultimately, under the sanction of a Charter, the Wearmouth Dock Company constructed a dock of 6 acres, which was opened for traffic in 1837, on the North side of the river. This dock does not appear to have been a financial success and it had the disadvantage that the entrance was exposed to the heavy seas that rolled up the harbour in stormy weather. In 1847, the York, Newcastle and Berwick Railway Company (now the London and North-Eastern Railway Company) purchased it, and in 1922, it was transferred to the River Wear Commissioners.

In 1846, an Act of Parliament was obtained authorising the Sunderland Dock Company to construct a wet dock and other works on the South side of the river, and in February, 1848, the first stone was laid by George Hudson, the "railway king," who was M.P. for Sunderland and Chairman of the Company. In 1850, the South dock was formally opened. The dock was practically built on the foreshore, the marl and rock excavated from the dock being deposited on the East, or seaward, side of the dock walls, and groynes and breakwaters erected. An extension of the dock was completed in 1855. A feature of the works was that whilst there was an entrance to the docks from the river, there was also an outlet which led direct from the dock to the sea, altogether independent of the river. The Company also built a graving dock for public use and particularly for the "coppering" of new ships.

The condition of the river had in the meantime been greatly improved by the Commissioners, the piers being altered and extended, the channel straightened and deepened by dredging and a very contracted part of the river widened and deepened, giving increased facility for the shipment of coal at the staiths which had been erected on the banks of the river.

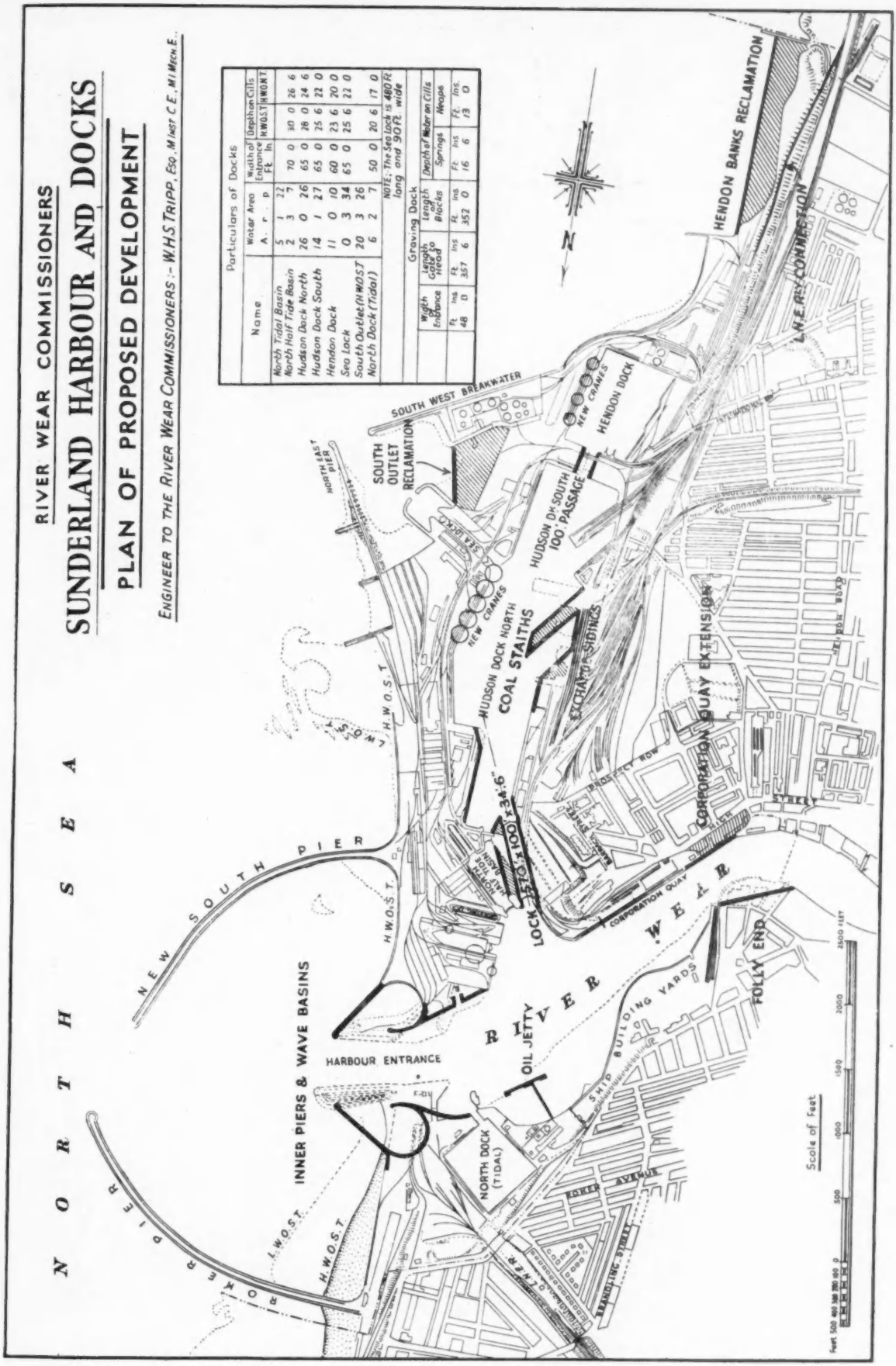
to time, and now consist of a half-tide basin, with an area of 2¾ acres and a length of quayage of 800-ft.; the North and South Hudson Docks, 41½ acres in area, with a length of quayage of 9,000-ft., and the Hendon Dock of 11 acres with 2,800-ft. of quayage. Modern coal-shipping appliances and electric and steam-cranes varying from 30-cwts. to 20 tons in lifting capacity, are provided on the different quays for the expeditious handling of cargoes. A new 60-ton electric crane, mainly used for installing machinery into new ships, is also available. A Simon's electric suction plant is provided for the discharge of bulk grain, for the storage of which there are two warehouses with a capacity of 50,000 qrs. Warehouses and transit sheds are also provided for the storage of general goods. Shipbuilding, marine-engineering, and ship-repairing establishments, as well as oil installations and timber yards, are located on the docks estate.

Protecting Piers

One of the greatest port improvement schemes ever undertaken by the Commissioners was the construction at the Harbour Entrance of two massive granite-faced protecting piers which sweep out into the sea in the form of two converging segments of a circle, enclosing a water area of about 125 acres and providing an easy and safe entrance to the port. The North Protecting Pier, or Roker Pier, at the end of which there is a fine granite lighthouse with a flashing light visible at a distance of about 15 miles, was commenced in 1885 and completed in 1903, and has a length of 2,880-ft. The South Protecting Pier, commenced in 1893, has a length of 2,700-ft.

Corporation Quay

Under powers conferred upon them by the "Sunderland Corporation Act, 1927," the Corporation of Sunderland built and opened for traffic in 1934, a deep-water general-cargo quay and contingent works in the River Wear, just above the entrance to the South Docks and only about half-a-mile from the open sea. The


RIVER WEAR COMMISSIONERS
SUNDERLAND HARBOUR AND DOCKS
PLAN OF PROPOSED DEVELOPMENT
ENGINEER TO THE RIVER WEAR COMMISSIONERS :- W.H.S TRIPP, ESQ., M.INST C.E., M.I.MECH.E.
Particulars of Docks
Name
Water Area A. r. p.
Width of Entrance Ft. In.
Depth on Cills H.W.O.S.T
Depth on Cills H.W.O.N.T
North Tidal Basin 5 1 22 70 0 30 0 26 6
North Half Tide Basin 2 3 7
Hudson Dock North 26 0 26 65 0 28 0 24 6
Hudson Dock South 14 1 27 65 0 25 6 22 0
Hendon Dock 11 0 10 60 0 23 6 20 0
Sea Lock 0 3 34 65 0 25 6 22 0
South Outlet (H.W.O.S.T) 20 3 26
North Dock (Tidal) 6 2 7 50 0 20 6 17 0
NOTE: The Sea Lock is 480 Ft. long and 90 Ft. wide
Graving Dock
Width of Entrance Ft. 48 In. 0
Length Gate to Head Ft. 357 In. 6
Length of Blocks Ft. 352 In. 0
Depths of Water on Cills
Springs Ft. 16 In. 6
Neaps Ft. 13 In. 0
NORTH SEA
NORTHER PIER
ROKER
NEW SOUTH PIER
INNER PIERS & WAVE BASINS
HARBOUR ENTRANCE
H.W.O.S.T
L.W.O.S.T
NORTH DOCK (TIDAL)
OIL JETTY
RIVER WEAR
SHIP BUILDING YARDS
FOLLY END
LOCK 350 FT. x 100 FT. x 34.6"
HUDSON DOCK NORTH
COAL STAITHS
NEW CRANES
EXCHANGE SIDINGS
CORPORATION QUAY
CORPORATION QUAY EXTENSION
HUDSON DOCK SOUTH
100' PASSAGE
SOUTH OUTLET RECLAMATION
SOUTH WEST BREAKWATER
NORTH EAST PIER
SEA LOCK
HENDON DOCK
NEW CRANES
HENDON BANKS RECLAMATION
L.N.E.RY. CONNECTION
PROSPECT ROW
STANLEY
TOWER AVENUE
TRAVELLING CRANE
Scale of Feet

PORT OF SUNDERLAND DEVELOPMENT PLAN

Port of Sunderland—continued

quay, which is managed for the Corporation by the River Wear Commissioners, is 1,062-ft. long and has a depth of water alongside, when newly dredged, of 30-ft. at L.W.O.S.T. It is equipped with a two-storey reinforced concrete warehouse and transit shed, four 5-tons and a 10-tons electric level luffing cranes, an electric coal-shipping conveyor, primarily used for bunkering purposes, and an oil-bunkering installation.

Owing to the displacement of the old fish quay by the erection of the Corporation Quay, a new Fish Quay, 300-ft. long, with a depth of 20-ft. of water alongside at L.W.O.S.T., was built by the Commissioners in 1938. It is situate a short distance upstream from the Corporation Quay, and has an open auction shed 150-ft. by 35-ft. and numerous office stores for the use of fish merchants.

Shipbuilding

Sunderland is the largest shipbuilding town in the world, having within the borough boundaries at the present time 9 shipyards with a total of 36 building berths. Eight of the yards are located on the banks of the river and one at the South Docks. Even during the first half of the 19th century, more ships were built at Sunderland than at any other place, and it is interesting to note that, apart from a company operating a yard re-opened during the war, the present shipbuilding firms were all established before the middle of that century. The first mention of shipbuilding on the Wear occurs in 1346, and much could be written about the history and development of this important industry, for which the town has so long been famous, but perhaps it will be of greater interest to readers to deal with the achievements of the past few years. Published figures show that the merchant shipbuilding output (completions) of United Kingdom firms from the outbreak of war to the end of 1944, totalled 1,240 vessels of 5,722,532 gross tons, and that of this total, 249 vessels of 1,524,980 gross tons, or 27% of the total tonnage, were built at Sunderland. The best year was 1942, when Wear shipyards turned out 58 vessels of 374,794 gross tons, a greater tonnage than any other shipbuilding district produced in that year. The Wear firm with the greatest output during the war period to the end of 1944 was William Doxford & Sons, Ltd., with 71 vessels of 478,304 gross tons, a total surpassed by only one firm in the country. All these figures exclude naval vessels, of which many different types, including Corvettes, Frigates, L.C.T.'s, L.S.T.'s, and Trawlers, have been built on the Wear. An unusual vessel recently built, engined, and completely fitted-out at Sunderland was an Admiralty hull-repair ship for use in the Far East.

The shipbuilding industry has fostered in the town the growth of a great many subsidiary and allied industries, of which the most important is that of Marine Engineering. There are five old-established firms with marine-engineering works in the river and docks, and Sunderland's reputation for steam and Diesel engines is in keeping with its high position in the shipbuilding world.

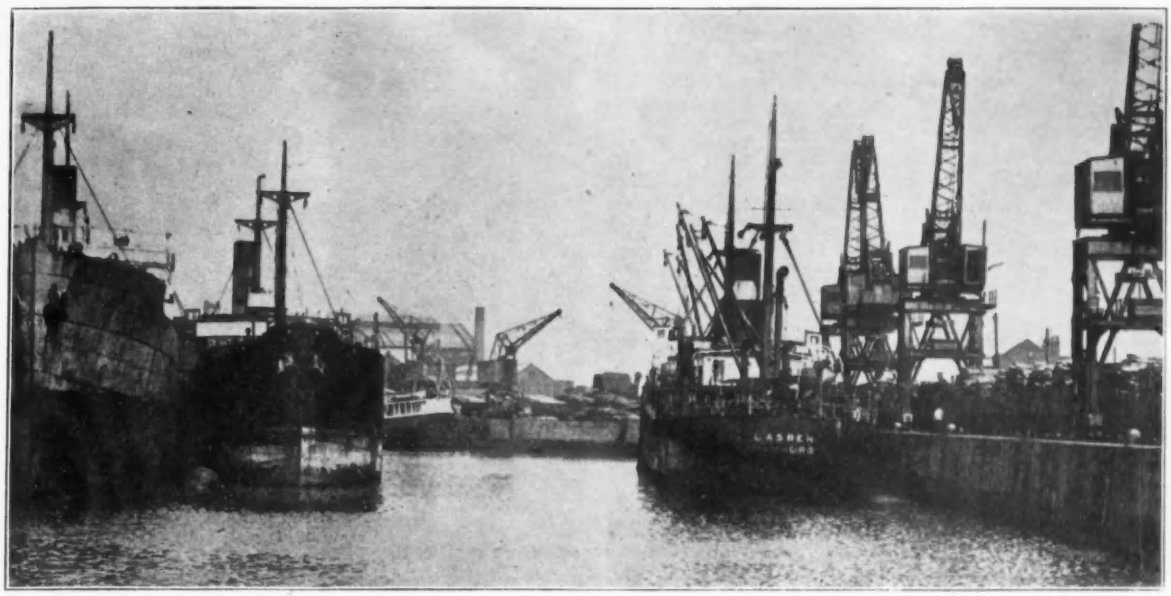
Ship-repairing is exceedingly well catered for in the port. In addition to a public graving dock owned by the River Wear Commissioners, there are three private graving docks, the largest being 500-ft. long and 75-ft. wide, with a depth of 26-ft. on the sill at H.W.O.S.T., as well as a pontoon dock and a small slipway.

Trade of the Port

From its geographical position in relation to the Durham Coalfield, it is natural that Sunderland's chief export is coal, and in normal times shipments aggregate about five million tons a year.

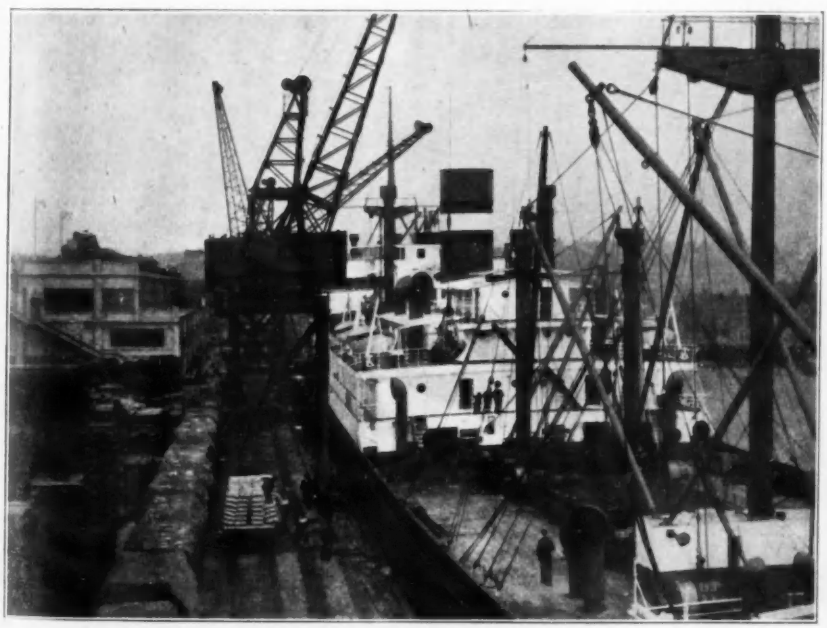
Shipping on the Wear.

Port of Sunderland—continued



The Docks, Sunderland.

The first exportation of coal from the port took place in 1396, but the trade did not develop to any great extent until 1642, when, during the civil wars, Parliament prohibited vessels from carrying coal from Newcastle (which espoused the Royalist cause) to London. By 1820, coal exports reached 1,115,812 tons, of which 1,001,163 tons were loaded into keels in the upper reaches of the river and brought down to the lower harbour and transhipped into the colliers. This quantity represented 47,225 keel-loads and the cargoes of nearly 7,500 ships. The balance of 114,649 tons was shipped by means of the first spouts which had been erected about 1815 on the South bank of the river. From that time the trade steadily increased until in 1904 it first exceeded five million tons.



M.V. "Damsterdyk," 6,337 n.r.t. loading binder twine at Sunderland Corporation Quay for Vancouver.

The port is now well-equipped for the shipment of coal, either as cargo or bunkers. About 2 miles up the river, on the South side, there are the private staiths of the Lambton, Hetton & Joicey Collieries, Limited, comprising five berths, equipped with eleven gravity spouts and an electric belt conveyor, with a depth of water of 17-ft. at L.W.O.S.T. On the opposite side of the river the Wearmouth Coal Company have a private staith equipped with three gravity spouts, and with 22-ft. 6-in. at L.W.O.S.T. in the berth. In the South Docks there are eight coal-shipping berths (one staith having been destroyed by enemy action) fully equipped with either gravity spouts or electric belt conveyors. In addition to these facilities, there is the coal-bunkering appliance at the Corporation Quay.

Other exports from the port include iron and steel, petroleum, machinery, pitch and tar, creosote oil and binder twine.

The principal imports are pitprops and other timber, iron ore, grain, esparto, wood pulp, petroleum, cement and iron and steel.

General Cargo Trade

During the war, the port lost a large part of its peace-time trade, coal shipments falling to about half the pre-war tonnage, but from 1941 onwards mixed general cargoes of great size and complexity have been handled in increasing volume. This work began at the Corporation Quay and the Government departments concerned were so well satisfied that they later doubled their demands and took in a South Docks berths as well as the quay. The traffic reached a high peak in 1944 when, in addition to substantial imports of general cargo, 165,000 tons were exported, against 103,000 tons in 1943, and 73,000 tons in 1938.

Like the authorities at other ports which in peace-time had a very limited general cargo trade and during the war have been called upon to deal with an exceptionally heavy volume of such traffic, the River Wear Commissioners are actively interested in the distribution of post-war liner services. They feel that, having proved beyond question that they have the facilities and ability to handle large quantities of general cargo, and

Port of Sunderland—continued

having served the country so well in its time of need, they are entitled to a fair share of liner services when normal peace-time trade is resumed.

Post-War Plans

Early in 1942, the River Wear Commissioners appointed a Planning Sub-Committee to draw up a programme of desirable improvements and new works, and since then they have from time to time submitted proposals for Government consideration. In preparing their programme the Commissioners conferred continuously with the Sunderland Corporation and the Wear Shipbuilders' Association, and in November, 1944, the whole subject was finally reviewed and a long-term programme drawn up and submitted to the appropriate Government Department.

No detailed estimates have yet been prepared, but the approximate total expenditure likely to be involved if the whole of the schemes were carried out would probably be in the region of £3,675,000, apart from the cost of property, compensation to existing owners or parliamentary bills. As to how the schemes would be financed, nothing has yet been decided, but Sunderland has played a very useful part in the prosecution of the war and has great potential value to the country in assisting in the process of trade recovery after the war, and the Commissioners and the Corporation therefore feel that they ought to be able to rely upon substantial Government backing in carrying out the programme stage by stage. They find encouragement for this belief in the Government's declaration in the White Paper on Employment Policy that the Government will take such action in development areas—and Sunderland, of course, forms part of one—as may be necessary to secure full development and stimulate the modernisation of docks and harbours.

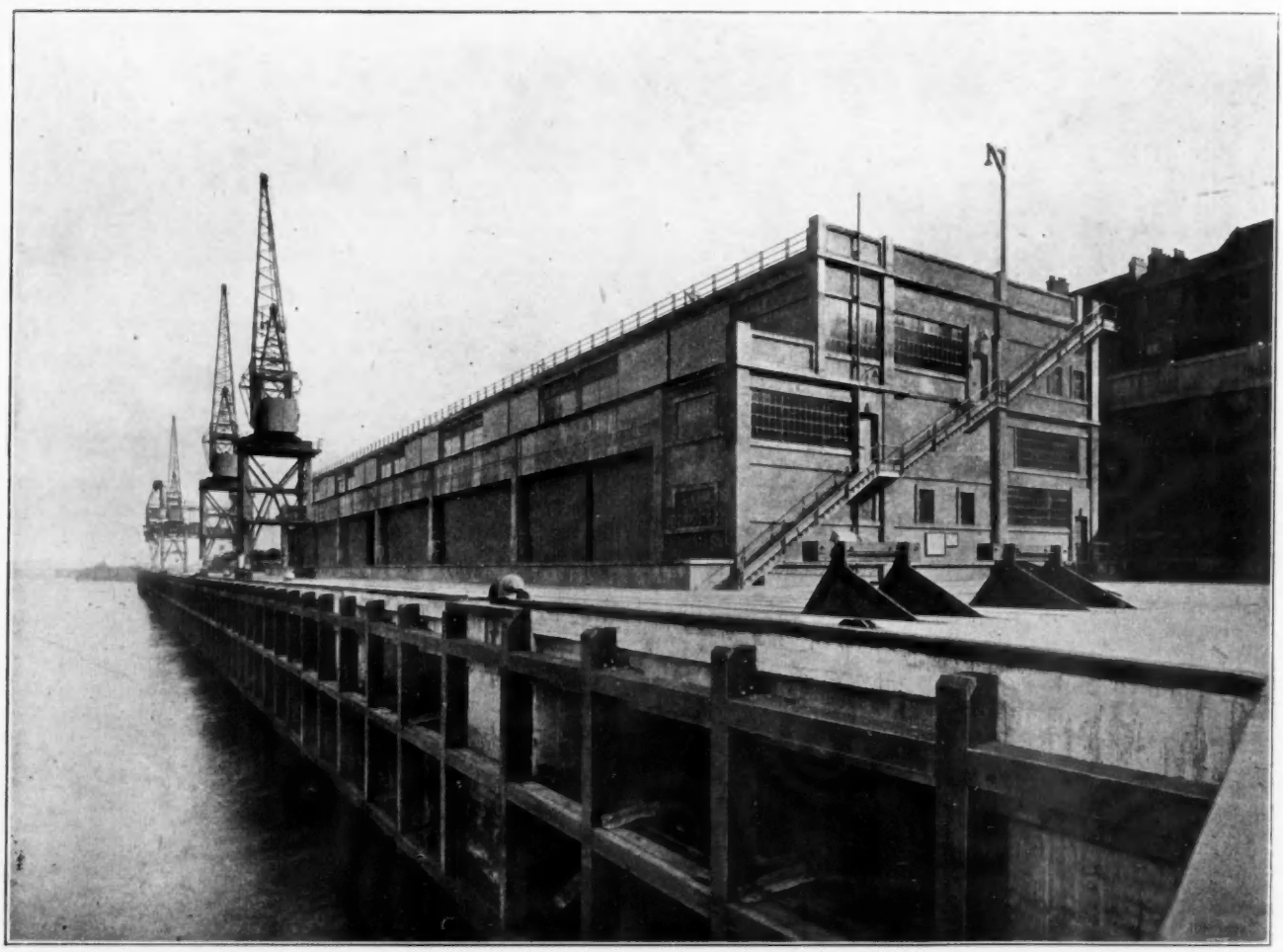
The improvement and development of port facilities at Sunderland will dovetail very aptly into the general plan for the industrial development of Wearside and Durnam County by the expansion of existing industries and the establishment of new ones to give that greater diversification and balance which are so much needed. The new industries to be introduced will, it is hoped, require first-class port facilities immediately at hand, and equally a well-equipped port should be able to do much to foster the rapid growth and prosperity of the industries themselves.

To refer to the principal schemes in the development programme, which are shown on the plan accompanying this article, I will deal firstly with the South Docks proposals.

The largest scheme is for the construction of a new entrance from the river to the South Docks system, by which the width would be increased from 65-ft. to 100-ft. and the depth at H.W.O.S.T. would be increased from 28-ft. to 34½-ft., which would permit the easy passage of the largest vessels ever likely to use the docks, including new ships built in the port.

In order to provide a complete range of modern coal staiths capable of the highest speed and efficiency, both in the handling of vessels and the shipment of cargo and bunkers, it is proposed to reconstruct and improve the older staiths to bring them up to the standard of the newer coal-shipping appliances in the docks.

The improvement of the East Quay South, Hudson Dock North, and the East side of Hendon Dock, is proposed, including the provision of more cranes of the most modern and efficient type for the handling of general cargoes.



Sunderland Corporation Quay: The Quay Front.

Port of Sunderland—continued

The proposed widening and deepening of the junction between the Hudson and Hendon Docks would open up Hendon Dock for larger vessels by increasing the width from 52-ft. to 100-ft. and increasing the depth from 23½-ft. to 30-ft. at H.W.O.S.T.

There is a great need for additional storage ground for pitwood and other timber and it is proposed to reclaim 12 acres of land to the South of Hendon Dock and 4 acres at the South Outlet, Hudson Docks, and provide the necessary railways thereon. The Hendon scheme would also prevent further coast erosion at that point.

The development of the Ballast Quay on the East side of Hudson Dock North would give a suitable berth to replace the Transit Shed berth, on the West side of the dock, which would be lost when the new entrance is built.

The Leith Wharf on the East side of the junction of the Hudson and Hendon Docks would be lost when the entrance to the Hendon Dock is widened, and it is proposed that it should be resited on the West side of the junction.

The provision of a second railway connection between the South end of the Docks Estate and the London and North-Eastern Railway is intended to provide a much-needed addition to the traffic facilities.

Turning from the docks to the Harbour Entrance and the River, the largest scheme proposed is the replacement of the old and rather decrepit inner piers with two new piers and wave basins. These proposed new works will improve the entrance and reduce the range in the lower reaches of the river.

The present depth of water in the harbour entrance channel at L.W.O.S.T. is about 15½-ft., which, with a rise of 14½-ft., gives 30-ft. at H.W.O.S.T. It is proposed to eventually increase the depth in the channel by dredging to 25-ft. at L.W.O.S.T., giving 39½-ft. at H.W.O.S.T.

A new oil-discharging berth is proposed to be constructed at the North side of the swinging basin in the lower harbour.

The widening of the river at Deptford, just over 2 miles from the harbour entrance, is envisaged with a view to improving navigation in the upper reaches, especially for passing new ships down from the shipyards

One of the most important schemes in the programme is the proposed extension of the Sunderland Corporation Quay to connect with the new Fish Quay. In addition to equipping the quay with four 5-ton cranes, it is proposed to erect a modern public cold store on the quay, thus providing another first-class general cargo berth and at the same time enabling frozen meat and other perishable commodities to be landed direct from ship into cold store. Sunderland is by far the largest town in Great Britain still lacking a public cold store, and the provision of a modern refrigerated warehouse at the quay extension would be an ideal arrangement, and would give the port a facility unequalled in the North-East. In connection with this scheme it is proposed that the river should be widened by removing the "folly end," which lies directly opposite to the site of the proposed quay extension.

The Port Authority

After detailing the foregoing plans for the future development of the port and docks, I think it is appropriate that I should conclude with a word about the present constitution of the River Wear Commissioners, who, as the port authority, owners of the docks and managers of the Corporation Quay, have drawn up the proposals and will be responsible for carrying them out.

Under the "Wear Navigation and Sunderland Dock (Consolidation and Amendment) Act, 1922," as amended by the "Wear Navigation and Sunderland Dock Act, 1938," there are 37 Commissioners, of whom 18 are elected, by the coal owners (5), shipowners (3), shipbuilders (3), importers and exporters (2), engine-builders (1), and the holders of mortgages and funded debt (4), 14 are appointed by the Sunderland Corporation and 1 by the Minister of Transport, and 4 (2 of whom are nominated by the Sunderland Corporation) are co-opted by the elected and appointed members. Elections are held and appointments made every three years.

With the affairs of the port in the hands of such a representative body, under the Chairmanship of Sir Frank Nicholson, C.B.E., there is every confidence that the policy of development and trade expansion will be vigorously pursued as soon as circumstances permit.

Manchester Ship Canal

Retirement of Chief Engineer

Mr. Fred Berry Greenwood, M.Inst.C.E., after fifty years service with the Manchester Ship Canal retired from the position of Chief Engineer on August 31st and has been succeeded by Mr. R. D. Brown, previously chief assistant engineer.

Mr. Greenwood is a native of Manchester. He joined the engineer staff of the Company in 1895—in the early days of the canal's history—and in 1901 he was appointed resident engineer of the Tidal Division; later, in 1911 he became assistant engineer to the Company and in 1930, was appointed chief engineer. Throughout his long and valued service he has been responsible for many important works which have taken place along the Canal, and he has had very serious responsibilities during the war years.

Mr. Robert Dunlop Brown, M.Inst.C.E., who succeeds him, joined the Company in 1922. He served his apprenticeship as a civil engineer with the Office of Public Works, Glasgow, and was engaged for seven years on tunnelling operations designed for the purification of the River Clyde. Apart from Army service in the 1914 war, Mr. Brown has, since his apprenticeship been continuously engaged upon the design and construction, in this country and abroad of large-scale public works. Before the last war he was employed by the Dominion Government of Canada in the Department of Railways and Canals, and for four years he was engaged in the design and construction of the Welland Ship Canal and its associated entrance harbours.

In the late war he was a member of the Panel of Consulting Engineers appointed by the War Office to design and prepare works required for the invasion of Europe. Among such works he was particularly interested in the means of rapidly gaining control over the outrush of land water and the action of the tides through openings created by the demolition of dams and lock gates. Small working models for the study of these conditions were prepared in great secrecy at Manchester. Mr. Brown was also consulted about certain harbour operations to be carried out in the Far East. He has recently returned from an official tour of United States ports.

The death at the age of 68 is announced of **Mr. William Grosvenor Smith,** M.I.Mech.E., late chief mechanical engineer of the Company. He had been continuously associated with the Engineering Department of the undertaking since its inception in 1894. He was appointed chief mechanical engineer in 1906.

New Deep-Water Quays at Leith.

Messrs Joseph Rank, Ltd., the flour millers of London, have been granted a lease of four acres of water and reclaimed land at Leith Harbour, on which the firm have agreed to construct deep-water quays for the berthage of ships conveying grain cargoes, together with the necessary plant equipment for handling the grain. Flour mills and ancillary works for the manufacture of feeding stuffs are also included in a programme of expenditure estimated at £750,000.

It will be recalled that before the war the Dock Commissioners undertook a scheme which provided for the enclosure from the sea of 250 acres of water and the reclamation of about 30 acres of land at a cost of over £500,000. Completed during the war, the scheme will undoubtedly prove of great value in the provision of an additional area for dock extension, and when fully developed will practically double the deep-water berth accommodation of the port.

Notes of the Month

Death of Ship Canal Director.

The death is to be recorded, at the age of 81, of Alderman W. T. Jackson, one of the directors of the Manchester Ship Canal. He was a former Lord Mayor of Manchester.

Peterhead Harbour Revenue.

Considerably increased revenue at Peterhead Harbour has been reported to the Trustees. The proceeds over the last six months have amounted to £7,692, an increase of £1,439 over comparable previous figures.

Leith Docks Commission.

Sir Gilbert Archer was appointed chairman of the Board of Leith Dock Commissioners on September 1st, in succession to Mr. Hugh Rose, C.A. The Commission has passed a resolution recording their appreciation of the work of Mr. Rose, who first joined the Commission in 1923 and also of Captain Harold K. Salvesen who has resigned from the Board.

Port of London Authority.

Mr. T. W. Condon, O.B.E., has been nominated by the London County Council to fill the vacancy for one of their representatives on the Board of the Port of London Authority, occasioned by the resignation of Mr. D. W. Large.

Having relinquished his war-time appointment under the Ministry of War Transport, Sir Robert Letch, formerly Regional Port Director for the North Western Area of England and subsequently for the Scottish Area, has resumed service with the Port of London Authority of London as Chairman of a Committee of Principal Officers set up to advise on questions of policy in connection with post-war reconstruction, development and organisation. Sir Robert is also chairman of the Merseyside Dock Access Committee and a member of a Commission of three appointed under the chairmanship of Lord Cooper to report on the proposed amalgamation of the Clyde ports. He has recently been elected by the National Association of Port Employers to the chairmanship of that body.

Institute of Transport.

At a luncheon given to the Technical Press by the Institute of Transport on 11th September, Mr. Robert Kelso, the President, occupying the chair, the President-elect for next year, Sir Frederick Handley Page, referred to the fact that the Institute was desirous of obtaining premises of its own in which to hold its meetings and carry on the business of the Institute. He did not propose the erection of a new building, but thought it might be possible to acquire some existing accommodation. In due time an appeal would be made to all the interests represented (rail, shipping, canal, road and air transport) to provide the capital required to bring the scheme to fruition.

Transport Minister's Scottish Tour.

Mr. Alfred Barnes, M.P., Minister of War Transport, toured Glasgow and the Clyde ports on September 4th. He met representatives of trade unions and dock workers at Princes Dock, Glasgow, before continuing to Greenock. In a press interview, Mr. Barnes declared that it was desirable in Britain's post-war plans that the Clyde should continue to play as important a part as she had in the past. Everyone knew the magnificent job which had been carried out during the war years, and the country was awake to the value of shipping in the economic life of the community.

At Greenock Mr. Barnes met Ministry of War Transport and port officials. Accompanied by Mr. W. S. Coutts (the chairman) and Mr. Donald Smith (general manager of the Greenock Harbour Trust), he made a tour of the existing facilities at the port and saw them under working conditions. Mr. Barnes expressed keen interest in the work of the port and in the post-war harbour development plans which were shown to him.

Haifa Port Extension.

It has been announced by Mr. A. F. Kirby, general manager of the Palestinian Railways, that plans are in hand for an extension of the accommodation at the Port of Haifa, to include two additional tanker berths in the oil dock, additional general quayage and the extension of cargo, docking and passenger landing facilities. Arrangements are also being made for the bulk handling of potash and grain. Work on the oil berths is to be commenced within a year's time.

Port Extensions at Alexandria.

It is announced in the press that the work of enlarging and improving the harbour accommodation at the Port of Alexandria, estimated to cost three million sterling, is to be put in hand within the next few months. Among the works to be carried out are the construction of a new bonded store, a new goods yard, in addition to important quay extension work and the erection of a zone for inflammable goods. The dredging of the harbour is said to be completed; it has cost over £150,000.

Clyde Lighthouses Trust.

The Clyde Lighthouses Trustees have been notified of the completion of a survey of the channel of the river in which it was found that the depth was well maintained below statutory level. There was a slight amount of silting close to the North bank, but the area affected was small and would be dealt with by dredging during next Spring. It was also announced that the restoration of all navigation aids in the area administered by the Trust was practically complete. The boom was almost entirely removed. The talking beacon at Cumbrae was in course of being installed.

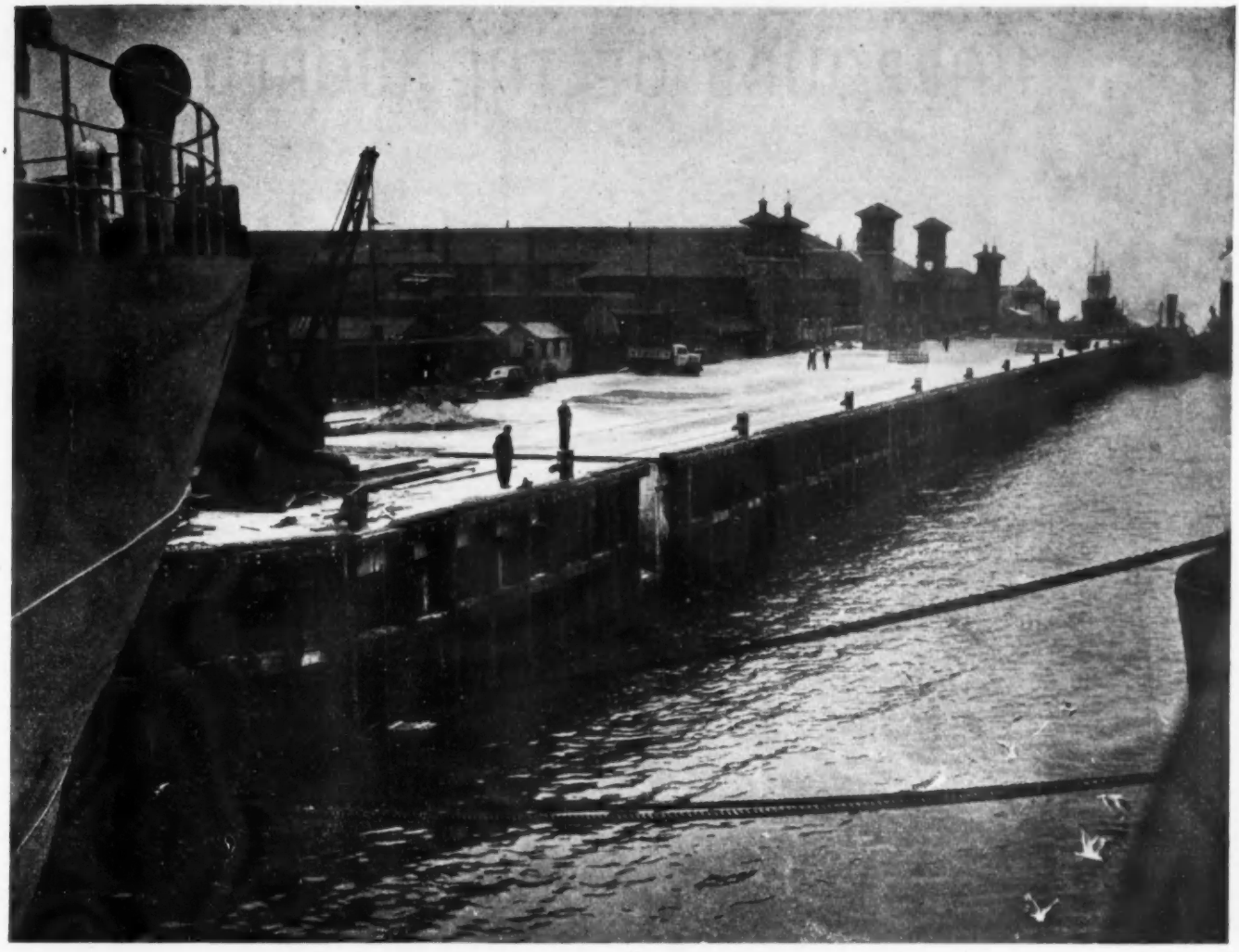
Departure of Clyde Dockers.

The last of the English dockers who came to the Clyde to work the Clyde Anchorages Emergency Port left on August 28th amid a demonstrative send-off from Gourock. The men and their families came north in September, 1940, and since then no less than 2,000 dockers have worked at the port daily to unload and load in what became, for the time, what must have been the busiest shipping port in the world. Gradually, as the need for shipments decreased, groups of dockers returned to London and other Southern ports, the above-mentioned group being the last to go.

Ministerial Visit to Merseyside.

A tour of inspection of the docks on Merseyside was made by the Minister of Transport (Mr. Alfred Barnes) on September 5th. Accompanied by Sir Thomas Brocklebank, chairman of the Mersey Docks and Harbour Board, and Mr. R. J. Hodges, the general manager, with Mr. R. P. Biddle, the North-west Regional Port Director, he visited in turn the more important docks at Liverpool and Birkenhead and some canteens and labour control centres.

Speaking to members of the Port Emergency Committee, Mr. Barnes said: "This is the first time I have seen the port at work under expert guidance and I have been very impressed. In my opinion Liverpool is one of the best planned ports in the country and well capable of handling the vast and varied tonnage coming in and going out. I wanted to meet as many as possible of the key men and others who are handing this great job and to say 'Thank you' on behalf of the nation for the way you have worked during the war, and to ask you to co-operate with us in the same spirit during the post-war period. I want to get to know them so that we can carry on this work as a team in the days of peace." He continued that such visits would acquaint him with the great organisations concerning the shipping of the port and he added, "I can now take away with me a picture of the whole of these activities and when proposals come before the Ministry I shall have that background picture in my mind."



We built this quay on paper

One of our recent contracts was for the complete reconstruction of Princes Pier for the Greenock Harbour Trust (Gen. Manager and Engineer : Donald Smith, M.I.C.E. Consulting Engineer : Arch. Henderson, M.I.C.E.). The old timber-pile landing stage was replaced by a reinforced concrete superstructure on steel-box piling up to 85ft. long with steel sheeting about 60 ft. deep and a relieving platform to about low water level.

Like all Wimpey jobs, this one was pre-planned in chart form to the last man-hour and the last plant operation. Before a single workman started work or a single crane moved, Wimpey's Regional Office (in this case Glasgow) had supplied all necessary local information; the programmes of all departments had been completed and co-ordinated; research, men, materials, plant, transport — all dovetailed; the whole master-plan interlocked.

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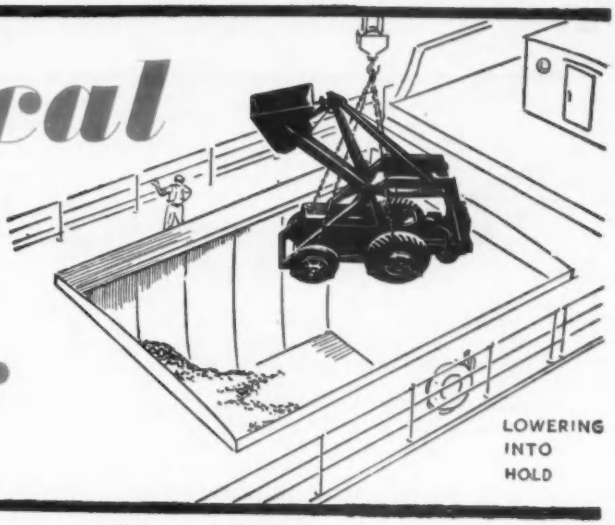
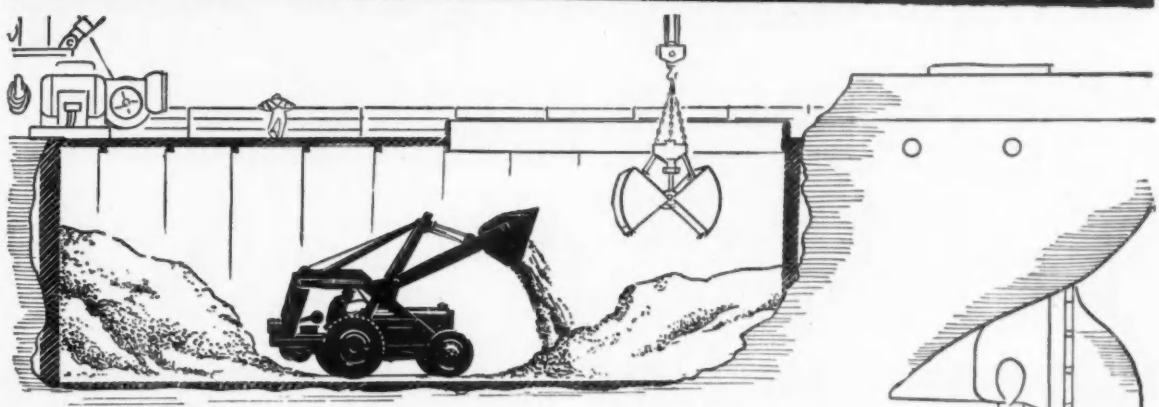
Mechanical dock labourer

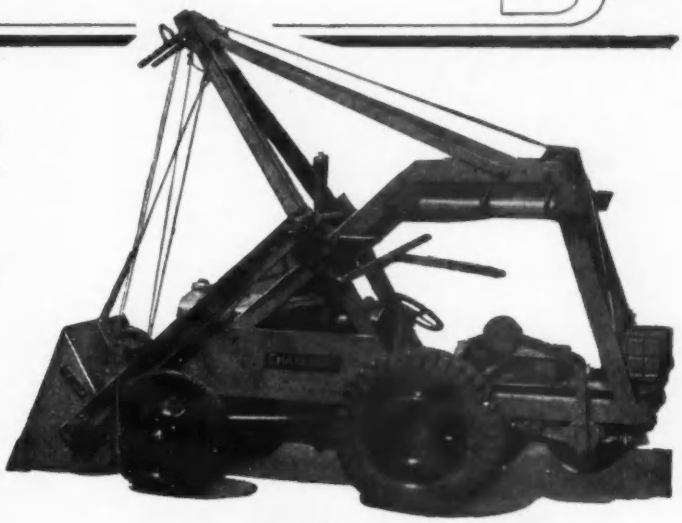


LOWERING INTO HOLD



SHIFTING CARGO TO SPACE UNDER HATCH

Where loose material is being carried—coal, for instance—considerable manual labour is needed in the hold to keep the grab fed. To-day the Chaseside Shovel is frequently used to do this, thus enormously speeding up unloading. Light, small and mobile enough to be lowered into the hold, it can do (with one driver) the work of ten men. It is just as useful a 'handle' on the quayside. Write for details.



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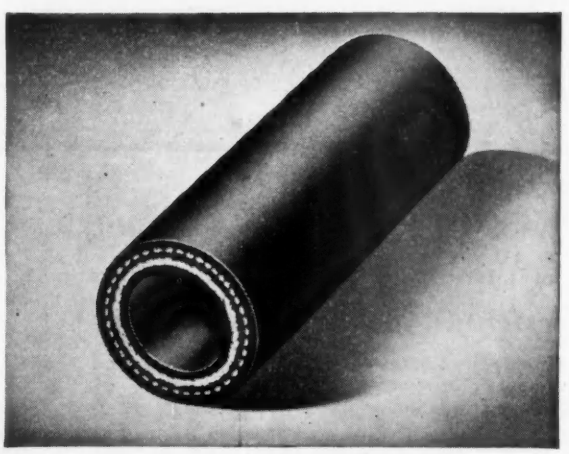
There is a very real reason for this, of course. For over a quarter of a century the Goodyear Research Laboratories have been accumulating experience and skill in methods of developing and *using* industrial rubber. The vast, unique store of knowledge they have built up goes into every Goodyear hose or belt, making it exactly right for the job. And if you are in any doubt as to which type of hose or belt you should use, let Goodyear specify it for you.

The Goodyear "Industrial Rubber Products Conservation" Handbook is to-day accepted as the standard work on the maintenance of hose or belting. Write for a copy, and send your technical problems as well, to: The Mechanical Goods Dept. (D.H.), Goodyear, Wolverhampton.

Conveyor Belts. Goodyear Conveyor belts are designed for the most rigorous requirements in handling abrasive and heavy materials. The rubber covering is tough and resilient, gives under impact; does not cut readily. Severe flexing conditions will not cause ply separation.



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"The Dock and Harbour Authority"

Some Notes in connection with its "Silver Jubilee"

"The Dock and Harbour Authority" owes it creation to a happy inspiration on the part of Mr. Harry Crowhurst, who, engaged in the service of the Admiralty during the 1914-18 war period, felt that there was scope for a Journal devoted to the interests of ports and harbours. Acting in conjunction with The Yachtsman Publishing Co. (now Foxlow Publications, Ltd.), of Harcourt Street, Marylebone, W.1, in the summer of 1920 he approached the present editor, who accepted the invitation to undertake editorial responsibility and (apart from an intercalary period from October, 1926, to February, 1937), has occupied the editorial chair since that date.

The Journal was launched at the beginning of November, 1920, from an office at 158, Strand, W.C.2. It may be of interest to reproduce part of the Introductory Editorial Comment in the first issue, which is as follows:—

"By Way of Introduction.

"Docks and Harbours have so long been relegated into obscurity and treated with indifference by the public that it is high time they came into their own and claimed 'a place in the sun.' Hitherto, in the popular view, transport has been a matter of ships and railways, and commerce a matter of goods and markets. In both cases there is a connecting link which has been conveniently ignored. Yet, how obviously essential is the part played by docks and harbours in receiving and sheltering shipping, and how indispensable are the quayside berths, sheds and handling appliances which alone render it possible for overseas produce to be transmitted, via railway or motor vehicle, to the consumer.

* * * * * *

"It is the aspiration of the founders of this Journal to supply a medium of information for the many varied interests associated with port management and control. Chiefly, the editorial aim will be to furnish particulars of developments which are constantly taking place in different parts of the world in the accommodation provided for shipping, together with descriptions of improved methods which may be introduced from time to time for the more expeditious handling of goods at the quayside and for the promotion of rapid transport.

"The purview is sufficiently wide to command a considerable circle of readers, and it is hoped the Journal will make an effective appeal to all who have at heart the advancement of mercantile enterprise and the fostering of overseas trade and intercourse. In the struggle for the possession of the world's markets there is every need for ports to be adequately equipped with the most modern appliances, and, at the same time for harbour authorities to be keenly alert to the possibilities of development along thoroughly scientific and practical lines.

* * * * * *

"We venture to hope that we may enlist the sympathetic interest and effective help of all our readers in order to render the Journal a really useful medium of information and service."

As regards the contents of the first number it may be stated that the leading article was on "Extensions and Improvements in the Port of London" by the Right Hon. Viscount Devonport (with portrait), at that time Chairman of the Port of London Authority. Then followed a paper from a Canadian engineer, Mr. A. W. Robinson, on "Larger Ships, Deeper Harbours and Better Dredgers," written, of course, from an American point of view. Next, there was an historical sketch of Thos. Telford, the eminent 18th Century engineer, and his association with the St. Katherine Docks, London, at that date nearing the centenary of their opening. A detailed account, with an illustrated supplement, was then given of the Port of Buenos Aires. Mr. G. F. Zimmer contributed an article on "Portable Loading and Unloading Devices for Cargo Handling." Under the title of "Port Granaries," a first article by Mr. G. H. Baxter, Mechanical Engineer to the Clyde Navigation Trust, described the Meadowside Granary, newly built at Glasgow. Mr. A. T. Best dealt with the "Supply of Liquid Fuel to Shipping in Ports," and after a notice of "Recent Developments at the Port of Falmouth," the issue concluded with a description of the Shipbuilding and Engineering Exhibition then being held in Glasgow. In all there were 34 pages of text.

The reception of this first issue was all that could be desired, and the Journal has continued thereafter to progress, without intermission, in the number of its readers and (it may confidently be claimed) in prestige as an acknowledged authoritative publication on matters within its purview.

Regional Port Directorships

Some Notable Changes

The Minister of War Transport has announced the discontinuance of the posts of Regional Port Director for the North-Eastern, Humber and Wash, and South-Western areas, respectively.

On September 15th Mr. B. Eliot Common and Mr. D. Bulay-Watson, Regional Port Directors for the North-Eastern and the Humber and Wash areas, respectively, and on September 30th Mr. R. Hugh Roberts, Regional Port Director for the South-Western area, were released from their official duties.

From the above dates the responsibility for securing the most efficient operation of the ports concerned has reverted to the respective Port Emergency Committees, under the general direction of the Ministry in London.

A further announcement is that Mr. R. P. Biddle, C.B.E., has been released as from October 1st from his appointment as Regional Port Director for the North-Western Area, in order to resume his former position as Docks and Marine Manager for the Southern Railway Company at Southampton. He is succeeded by Mr. R. J. Hodges.

Mr. Biddle joined the Ministry of War Transport in 1941, as deputy Director of Ports. He was made C.B.E. in September, 1944, for his services in connection with the planning for the landings in Normandy, and in April this year he succeeded Sir Robert Letch as Regional Port Director for the North-Western Area of England.

Mr. Hodges, in addition to a wide experience of shipping matters, has a close knowledge of local labour problems, having been General Manager and Secretary of the Mersey Docks and Harbour Board. Following service with the Cunard Steamship Co., Ltd., from 1919 to 1930, Mr. Hodges became Manager and later Director of Anchor Line (Henderson Bros.), Ltd., before joining the Mersey Docks and Harbour Board in 1935.

Shunting Developments at the Quayside

By A. G. AREND.

Although improvements in the shunting devices used for trucks and waggons on railways have been somewhat slow of being implemented in actual practice in some quarters, the same cannot be said of developments which have been made elsewhere. At not a few dockside and reloading station sites, space has to be specially allocated to allow the shunting winches to be properly housed, while when the mechanism is located mainly beneath the ground level, this involves much extra work. In one arrangement for shunting railway cars on the Continent, the outfit included six electric capstans of from 1 to 1½ tons tractive capacity, and three shunting winches of 2 tons tractive capacity. These latter were purposely constructed of extra narrow build so as to permit them being located between tracks, which was of special value at busy quarters. Instead of depending on the locomotive requiring to position waggons or trucks so far, to assist their ultimate link-up when stationary by manual means (as still appears to be necessary

Portable Capstan

in some parts), haulage cables attached to one or other of these devices rendered much of this work unnecessary. The shunting winches were equipped with sliding roller-borne guard covers, while instead of having to manipulate lever and control wheels, these were substituted by push-button control. The advantages so gained, however, were slight compared with one of the latest improvements which hails from the U.S.A., namely, the portable outfit which has been termed a motorised electric car "spotter." It may have already been noted how the latest tiering trucks have provisions for plugging-in to existing current supply so that batteries, or fuel-oil engines for supplying the power are unnecessary. The same tiering truck can be run to, say, a dozen different locations, "be plugged-in," and fully operated with the utmost efficiency.

The Portable Shunting Capstan

A further development of this is seen in the modern "spotter" where, instead of the shunting winch or capstan being stationary, it is housed at one end on wheels, with a bracket frame at the other end upon which it rests when not being transported. The outfit is so balanced on a channel-iron frame that this latter end can be readily lifted to roll it to any fresh location by one man. All that then has to be done is to anchor the frame with a chain and plug in the electric cable to a nearby power outlet, when the capstan is ready for putting into service. When any truck or waggon has to be moved, the haulage cable is hooked to it, while the other end is wrapped around the capstan. The cable is then fed away, while the actual pulling is done by the machine. As with the improved tiering truck, the only difference in the layout generally is the need for numerous power outlets which have to be set along ranges at convenient points.

The independence gained in shunting in this manner corresponds to that obtained with the tiering truck, and as a consequence fewer engines are required at busy sidings, and thus can be engaged on more important work.

(In other directions proposals have been made to utilise the same equipment for clearing damaged vehicles at busy thoroughfares and crossings, instead of having to await the arrival of the traditional breakdown waggon).

Locomotives for Facilitating Shunting

Shunting service has been assisted in certain areas by the use of locomotives with Diesel engines, and also petrol-electric power, which have the advantage that no steam pressure has to be maintained, or clinker to be removed at the termination of the day's work.

Improved models of the petrol-electric types, which are started like automobiles, have the speed of the locomotive regulated solely by the one hand-wheel, as no rheostats or other controllers are necessary, and all that is necessary is to increase or diminish the fuel-oil supply.

Only one other control organ has to be operated by the driver, namely, the reversing lever, to set the direction of travel, and this is caused to function in conjunction with the same hand-wheel. Operations are more or less on automatic lines, since the speed of the locomotive increases with the rising speed of the dynamo without any attention on the part of the driver, whereby when hauling a larger load, or climbing a gradient, the speed automatically decreases, and *vice versa* in the opposite instance.

Compressed Air Turntable

As regards locomotives themselves, instead of the slow manual method of operating the turntable, this is to-day done by motors operated by compressed air in modern railways. The compressed air is supplied by the locomotive itself, while the motor has the reduction gear from the existing gear-box of the turntable to apply the power in the most approved manner. In the event of any breakdown, or unexpected contingencies arising, a hand crank is left available, to be thus independent of the motor. As with other compressed air motors, reversing is performed with the same characteristic ease. While this is perhaps not of the same importance to shunting service in the ordinary way, it goes to show the general tendency to speed up activities where the most rapid transport of goods is desired. On the other hand, the narrow shunting winch located between tracks, the portable capstan, and the type of shunting locomotive which is always ready at hand without awaiting the raising of steam, all contribute to facilitate immediate handling.

Not a few of the demurrage problems, and hold-up of goods waggons at the dockside and other rail locations could be alleviated if more attention were to be devoted to these small items, and it remains to be seen how far advantage of these will be taken in the future. This is probably seen in the most pronounced manner where shunting necessitates climbing a gradient and which, without these facilities, is apt to be unduly retarded.

Port of Bristol Authority

Retirement of General Manager

Mr. Roland H. Jones, O.B.E., retired at the end of September from the position of General Manager of the Port of Bristol. Entering the service of the Bristol Docks Committee in 1893 he has completed nearly 52 years of official duty in the undertaking. Rising through various grades, he became assistant to the general manager of that date in 1911, was appointed acting general manager in 1931 and became general manager in 1932. He has been a member of numerous joint boards dealing with wages and conditions, of the advisory committee of the South-West Area, of several committees dealing with the regulation and diversion of shipping and the distribution of trade, and is a member of the National Dock Labour Corporation. He is also chairman of Bristol Port Emergency Committee. In 1920 he was appointed an O.B.E. for special services rendered to the Ministry of Shipping.

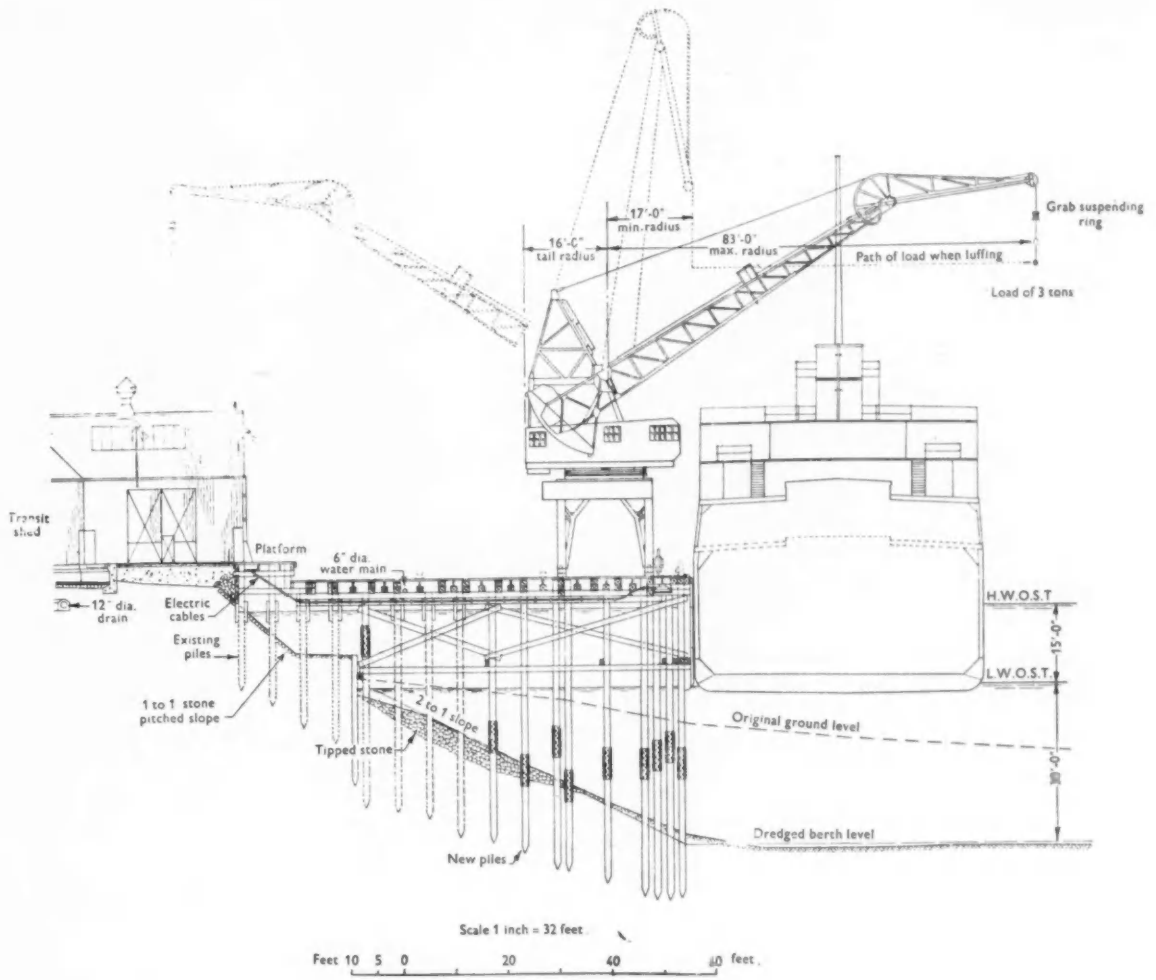
For a number of years Mr. Jones has rendered valuable assistance to general port affairs as a member of the executive committee of the Dock and Harbour Authorities' Association. He is a member and a former vice-president of the Institute of Transport and a Fellow of the Royal Society of Arts.

Mr. Jones is succeeded in the general managership of the Port of Bristol by Mr. F. D. Arney, the deputy general manager.

*Two New Quays at Tyne Dock, South Shields**

By ALFRED LAIRD HARVEY, M.C., B.A., M.Inst.C.E.

(Continued from page 118)



SUTHERLAND QUAY SECTION B-B.

SUTHERLAND QUAY.

General Description.—The Sutherland quay was begun in February, 1941, and completed in September, 1942. It is of timber construction, 450-ft. long and 87-ft. 4-in. wide, and has five lines of railways and a crane-track (Fig. 3 and Fig. 7). The depth of water alongside is 30-ft. at Low Water of Ordinary Spring Tides. The quay is equipped with four 3-ton electric cranes and eight capstans of similar construction to those at the North-west quay. The cranes have a clear outreach beyond the face of the quay fenders of 66-ft. 5-in.

Along the back of the quay is a raised platform of 10-ft. wide, within reach of the cranes, giving access to a single-storey transit shed, with a floor-area of about 43,000 sq. ft. This shed, which is steel-framed and corrugated-sheeted, has continuous doors along all four sides, with a clear headway of 14-ft. The level of the shed floor, which is surfaced with 2-in. of bituminous macadam, is 3-ft. 4-in. above quay-level. There is a siding along the back of the shed and a platform for road traffic along the west end of it. Vehicles can enter the shed by ramps at the ends of the front and west platforms.

Two mobile 2-ton Diesel cranes, three petrol-driven industrial trucks, two runabout battery-driven electric trucks, and gravity roller conveyors have been provided for the handling of goods.

A new roadway 20-ft. wide, surfaced with 3-in. of tar macadam, connects the quay with the Jarrow road more than half-a-mile away on the south boundary of the Dock Estate, and with the North-west quay.

Railways and Crane Track.—Rail traffic is handled principally from the west end of the quay through a new set of exchange sidings with a total standage of 1,627 yards, constructed on the reclaimed land between the Riven Don channel and the Railway Company's sidings. These sidings are laid with serviceable 90-95 lb. bull-head rails and a combination of concrete pad and timber sleepers. The railways on the quay are laid with new 90 lb. flat-bottomed rails set flush with the deck, the radius of the curves and turnouts being 5½ chains. The radius of the curves and turnouts between the west end of the quay and the exchange sidings is also 5½ chains, the maximum radius site conditions would permit, the gauge and flangeways being widened ½-in. to

*Paper read at Maritime Engineering Division Meeting of the Institution of Civil Engineers 13th Feb., 1945. Reproduced by permission.

Two New Quays at Tyne Dock, South Shields—continued

suit the Railway Company's locomotives. The turnouts at the south end of the sidings and elsewhere are of the Railway Company's standard types in new 95 lb. bull-head rail. At the east end of the quay there is a single line connection with the railways serving the North-west quay and a dead-end siding which continues along the existing river frontage.

The crane track consists of two single lines of 90 lb. flat-bottomed rail with a continuous ½-in. sole-plate 8½-in. wide, riveted to its base.

Design of Quay.—The river frontage on the west side of the entrance to Tyne Dock, where the Sutherland Quay is situated, was constructed at the time the dock was built and consists of a timber piled wharf, curved in plan, known as the "Black Jetty," with a depth alongside of 3-4-ft. at Low Water of Ordinary Spring Tides. In 1914 the North Eastern Railway Company removed about 350-ft. of this wharf near its western end and began the construction of a timber piled quay with 25-ft. of water alongside at Low Water of Ordinary Spring Tides, which was to have extended in a straight line from the present River Don channel as far as the dock entrance. The work, however, was abandoned after a portion of the inshore substructure opposite the gap created in the Black Jetty had been built. This consisted of a line of timber sheet-piling, 285-ft. long, intended for the retention of the ground along the back of the quay, and 172 timber bearing piles driven in rows on either side of the sheet-piling.

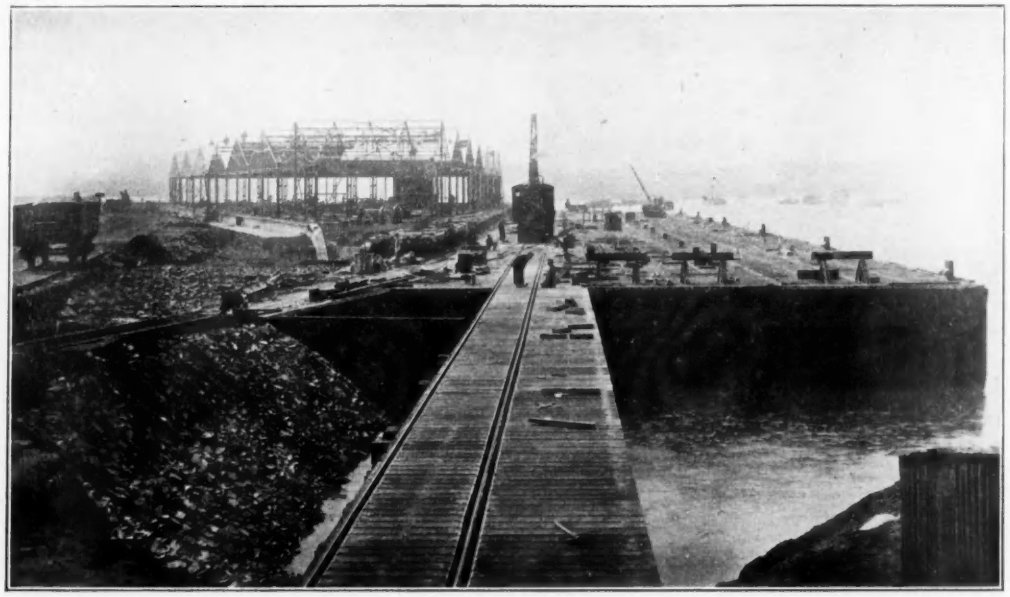
All this piling, which had been in position for about 26 years, was in good condition and three of the piles, when tested, each successfully sustained a load of 50 tons. Borings taken in connection with the proposed reinforced-concrete quay, referred to in the introduction, showed the underlying material to be sand to a depth of at least 57-ft. below High Water of Ordinary Spring Tides, and test-piles driven in accordance with the method described, showed that its driving resistance ranged from 500 lbs. per sq. in. to 1,500 lbs. per sq. in.

By building the quay on the site of the quay begun by the North Eastern Railway and adopting the same alignment, it was possible to make use of the sheet-piling and bearing piles already driven, and this was an important consideration as the existing sheet-piling represented nearly half the total length required. Furthermore, there was a sufficient supply of Oregon pine timber of 14-in. by 14-in. section available in the district for the work to be put in hand at once, at a time when steel and cement were hard to obtain. A design in timber was therefore decided upon.

The timber piling already driven consisted of twenty-two bents of eight pitch-pine 13-in. by 13-in. piles 6-ft. apart centre to centre transversely. These bents were spaced at 16-ft. intervals, having been intended for use with steel cross-ties and rail beams. As 16-ft. would have been too great a span for timber beams carrying railways and cranes, new bents were introduced midway between them in order to reduce the spacing to 8-ft.

The total number of piles in each bent along the main portion of the quay is seventeen, and they have been spaced so as to restrict the load carried by each pile to about 20 tons.

The tops of the bents are framed with double cross-ties made of half-timbers (14-in. by 7-in.) checked 3½-in. into the piles. The rail beams consist of a single whole timber with whole timber saddles, and the crane beams of three whole timbers, one on top of the other. The lower cross-ties, which run just above low-water mark, and the diagonal bracing are all of half timbers, whilst the deck joists are made of whole timbers sawn into three. The saddles of the rail beams are checked 2-in. over the top cross-ties. The deck planks are 11-in. by 4-in. and are laid with 1-in. gaps. The coping and rubbing-pieces are of 6-in. home-grown oak secured with bolts and trenails.



Sutherland Quay. August, 1942. View from East end. Transit shed under construction.

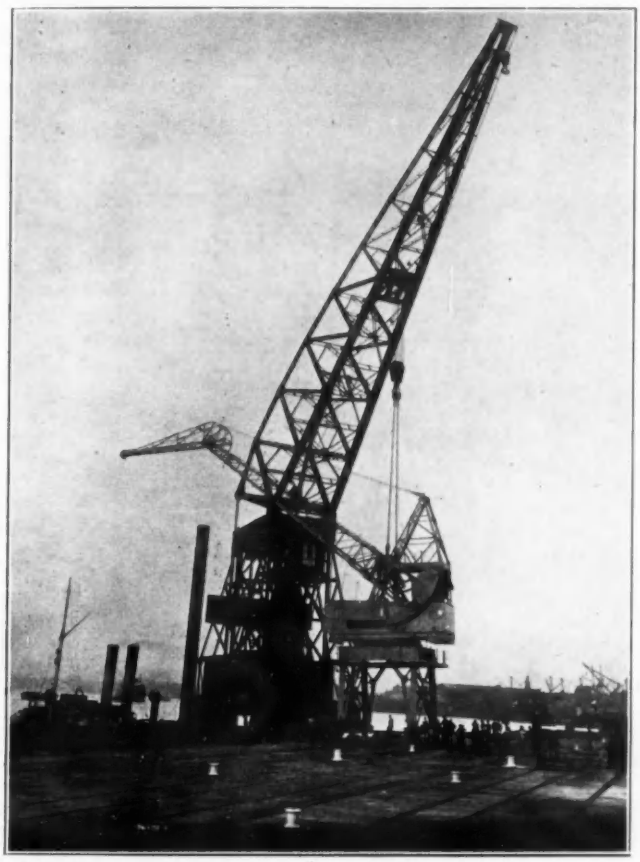
The sheet-piling follows the line of the fifth row of piles and is kept in place by a longitudinal waling bearing against this row of piles at the level of the lower cross-ties. Both piling and waling are of whole timbers, 12-in. by 12-in. section, and the former is cut off at 6-ft. 6-in. above Low Water of Ordinary Spring Tides. Inside the line of the sheet-piling is a berm and a 1-to-1 stone-pitched slope which continues up to deck-level. In front of the sheet-piling a 2-to-1 slope leads down to the dredged berth (Fig. 7). All of this timber, except the decking, was of the grade of Oregon pine known as "merchantable" under the Pacific Timber Inspection Bureau's rules, and the stresses worked to were those recommended by the National Lumber Manufacturers' Association* The decking was also of Oregon pine, but of a lower grade termed "No 1 and 2 common." Bolts and fastenings were kept to the minimum in order to facilitate construction and special toothed washers were used wherever a saving in bolts could be effected by so doing.

* "Wood Structural Design Data," Supplement No. 1 (Washington, D.C., 1939). The British Standards Institution has since issued grading rules for Structural Timber where the stress is known. (British Standard Specification No. 940, pt. 2).

Two New Quays at Tyne Dock, South Shields—continued

Creosoting.—Marine worm (*limnoria*) is active in this part of the river and all the timber, except the decking and fendering, has been incised and creosoted. It was specified that the creosote should penetrate the timber ¾-in., as shown by borings taken between the incisions. The average quantity of type A creosote required to give this result was about 6.3 lbs. per cubic foot. The procedure followed is described in Appendix I.

Construction.—The front of the new quay is about 130-ft. inside the face of the Black Jetty at the west end and about 20-ft. behind it at the east end. Considerable dredging had, therefore, to be done before the piling could be driven. This work was carried out by one of the Commissioners' bucket ladder dredgers in two stages, the total quantity involved amounting to 411,000 hopper-tons. In the first stage, which took 22 working weeks, the whole



Sutherland Quay. August, 1942.
3-Ton electric crane being lowered into position by 150-ton floating crane Titan II

of the off-shore ground in front of the face-line of the quay was dredged to the full depth, namely, 30-ft. at Low Water of Ordinary Spring Tides. No attempt was made to form the designed slope of 2-to-1 between the front of the berth and the existing sheet piling, where the original ground level stood at about low water mark, and the material was allowed to break back and take its own slope as the dredging proceeded. This slope turned out to be 3 to 1 instead of 2 to 1, with the result that about 5-ft. of material was left behind by the dredger in front of the quay to be removed in the second stage (Fig. 7).

Below low water mark the ground proved to be coarse and fine sand in layers, but hard clay was unexpectedly encountered at about 28-ft. below Low Water of Ordinary Spring Tides, all along the berth some 20-30-ft. from the face of the quay

At the east end of the quay, where no piling existed, the initial dredging was carried out only to 20-ft. at Low Water of Ordinary Spring Tides, leaving 10-ft. of material in the berth for subsequent removal. The 1-to-1 stone-pitched slope at the top of the bank and the berm were first of all formed by hand, the material, mostly refuse from a former chemical works, being cast down to the dredger. Pile-driving was begun at the west end, the inner rows being driven first with frames travelling on the piles. The outer rows were driven by a floating pile-driver. The designed penetration of the piles was 20-ft., and this was satisfactorily attained except in the case of the front rows where, owing to the presence of the clay, 15-ft. and in some cases, only 10-ft. was obtained. The timber for the piling was available only in 45-ft. lengths and 623 out of the 1,069 piles driven had to be spliced.

The designed penetration for the new sheet-piling was 24-ft. This was easily achieved at the west end of the quay and about 20-ft. was attained at the east end. The driving, however, was found to be much harder along the east approach and the assistance of a water-jet was found necessary. The piles were all driven with 2-ton single-acting steam-hammers having a 3-ft. 3-in. stroke.

The second stage of the dredging was carried out a year later, in July and August, 1942, after the quay had been completed to deck-level, the surface of the slope in front of the sheet-piling having first been made up where necessary to the designed slope with tipped stone. This stone, in combination with the piling, appears to have had the desired effect of stabilizing the bank beneath the quay at an average slope of 2 to 1 and very little material has since slipped down into the berth.

The quay was formally opened on 17th September, 1942, by Colonel Sir Frank R. Simpson, Bart., C.B., M.Inst.C.E., Deputy Chairman of the Commissioners.

Equipment

Electric Cranes.—The cranes span the front line of railway on both quays, the gauge of the crane track being 17-ft. The particulars are as follows:

	10/5-ton crane.	5/2½-ton crane.	3-ton crane.
Weight: tons	130½	87¾	81½
Maximum radius: feet ...	60	65	83
Minimum radius: feet	20	17	17
Tail radius: feet	14	16	16
Height of lift above rail-level at maximum radius: feet ...	70	57	57
Hoisting speeds: feet per minute	10 tons 15–60 5 tons 30–120	5 tons 13–120 2½ tons 22–200	28–200
Luffing speed: feet per minute	75	100	150
Sluing speed: revolutions per minute	1	1·22	1·15
Travelling speed: feet per minute	40	40	50

Each crane is fitted with safe-load indicators and has two special cargo lights in front of the cabin. The hoisting motion is performed by a variable-speed three-phase commutator motor with regenerative braking.

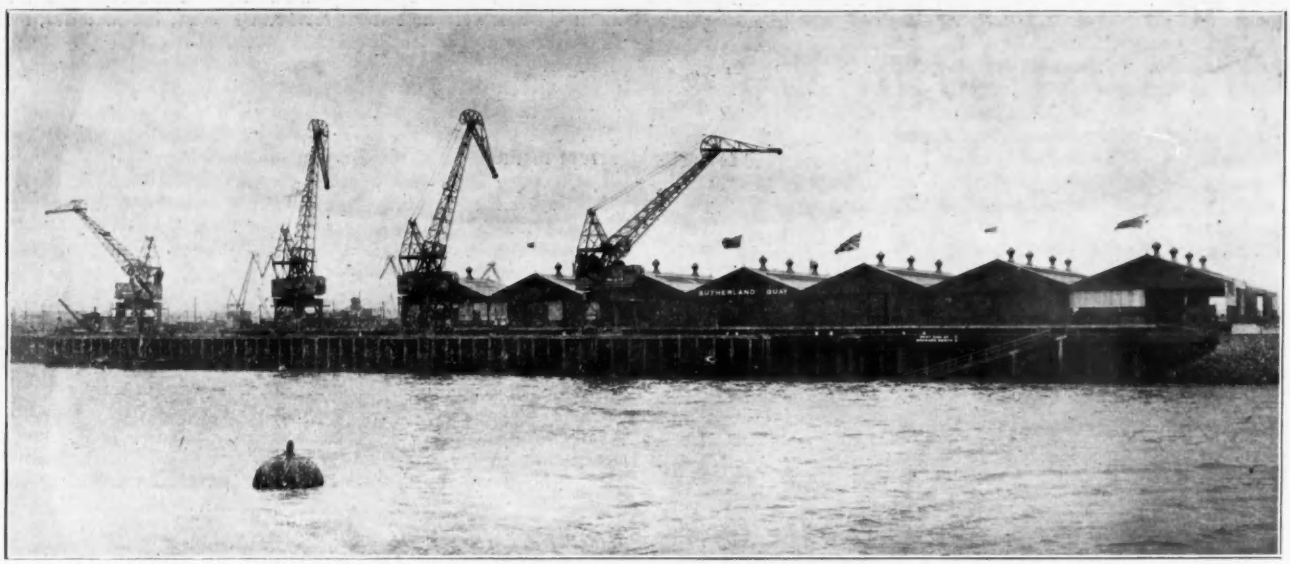
In addition to general cargo, the cranes are suitable for discharging iron ore, and eight ring-discharge single-chain clamshell grabs with teeth have been provided.

Capstans.—The nineteen electric capstans are of the fixed head type, capable of exerting a pull of 1½ tons at a speed of 130-ft. per minute. Tests showed that a slightly smaller capstan of this type, rated to exert a pull of 1½ tons at a speed of 100-ft. per minute, would haul eleven loaded private-owner waggons with a total weight of 200 tons on a straight level track at a speed of 120-ft. per minute.

Bollards, Hydrants, etc.—Captain Bean's patent bollards are provided at 120-ft. intervals along the front of the North-west quay and at 88-ft. intervals along the front of the Sutherland quay. These are all of the mooring type, except at the North-west quay, where certain of the intermediate bollards are of the warping type. In addition, a large circular bollard has been placed at both ends of the North-west quay and at the east end of the Sutherland quay. Fresh-water hydrants are provided at intervals and there are also plug boxes for cargo lights.

Weighbridges.—A new weighbridge of the self-contained dial indicating relief road type, to weigh 40 tons, has been provided at the sidings behind the North-west Quay and also at the Sutherland quay exchange sidings.

Two New Quays at Tyne Dock, South Shields—continued



Sutherland Quay. September, 1942. View of completed quay.

Acknowledgments

The works were designed and carried out under the direction of Mr. R. F. Hindmarsh, M.Inst.C.E., Engineer-in-Chief to the Tyne Improvement Commissioners, to whom the Author, who acted as his Assistant, is indebted for permission to present this Paper.

Messrs. Rendel, Palmer and Tritton acted jointly with Mr. Hindmarsh in the preparation of the original scheme for the development of the river frontage.

Mr. W. H. Dickenson, M.Inst.C.E., was the Resident Engineer until his retirement in June, 1941. Major R. J. Hindmarsh, R.E., Assoc.M.Inst.C.E., was Assistant Resident Engineer until the outbreak of war in August, 1939, when he was succeeded by Mr. H. R. Hogarth, who afterwards became Resident Engineer when Mr. Dickenson retired. The Commissioners' Electrical Engineer, Mr. W. Copeland, and his successor, Mr. W. R. Shepherd, supervised the electrical work.

The contractors for the quays, the transit shed foundations, etc., and the roads were Messrs. Brims & Company, Limited, and the railway work was carried out by Messrs. Thomas Summerson & Sons, Limited, and the London & North Eastern Railway Company. The test-piling was done by the British Steel Piling Company, Limited, with their own ground testing plant.

The cranes and capstans were supplied and erected by Messrs. Cowans, Sheldon & Company, Limited, and the transit shed by Messrs. Wright, Anderson & Company, Limited. The electrical gear was supplied by the British Thomson-Houston Company, Limited, in the case of the cranes and by the English Electric Company, Limited, in the case of the capstans.

The respective capital costs of the two quays are given in Appendix II.

APPENDIX I.

Creosoting

Procedure followed for creosoting 14-in. by 14-in. section Oregon pine of " merchantable " grade.

The timber, having been scraped and cleaned, was incised in accordance with British Standard Specification No. 913. It was then placed in the creosoting-cylinder and was subjected to an initial vacuum of 28-in. of mercury for from ½-hour to 1½ hours in order to dry it sufficiently to ensure proper distribution and penetration of the creosote.

The cylinder was then filled at atmospheric pressure with creosote oil heated to a temperature of 160° Fahrenheit. Steam was introduced into heating coils situated in the bottom of the cylinder and the temperature was increased over a period of 2 hours or so to 180° Fahrenheit. A pressure of 150-160 lbs. per square inch was then applied for 10-12 hours, the temperature of 180° Fahrenheit being maintained throughout.

As soon as the pressure-pump was released, the creosote was run off and the vacuum was re-applied for from ¼-hour to ½-hour to remove the surplus. This completed the process and the timber was then tested for penetration by boring.

APPENDIX II.

Costs

Capital Cost of North-West Quay.	£
Trial cylinder	2,010
Test-piles	301
Quay and railways	176,114
Dredging	4,649
3-ton and 5/2½-ton cranes and capstans	48,143
Grabs	1,834
Electrical equipment	6,932
Miscellaneous	4,492
Total	£244,475

The cost of the 10/5-ton crane was £11,767.

Capital Cost of Sutherland Quay.	£	£
Preliminary works and test-piles		2,074
Quay		134,039
Cranes and Capstans		28,634
Railways		34,497
Electrical equipment		9,481
Dredging		21,375
Transit shed	14,428	
Foundations, floor, platforms and paved area	18,131	
Electric lighting for shed	1,465	
		34,024
Roads		12,404
Mobile cranes and industrial and runabout trucks		6,195
Miscellaneous		5,854
Total		£288,577

(To be continued.)

Impact Stresses in Jetties, Wharves and Similar Structures

A Critical Analysis

By P. GARDE-HANSEN, B.Sc.,
Assistant Manager, Christiani and Nielsen, Ltd.

(Concluded from page 122)

Stresses in the Structure proper.

The structure proper will always have a deck and may for very high structures in tidal waters also have a low-water bracing, the whole structure being supported by piles. As far as lateral forces are concerned the structure functions as a continuous beam on elastic supports. The beam is formed by the deck or by the deck and the bracing framework below this. The supports are the pile bents below the deck or below the low-water bracing as the case may be.

If the superstructure is infinitely rigid in relation to the piles, i.e., if equations (6) and (10) give the result that the impact force is distributed over a practically unlimited number of supports, it will no longer be correct to consider the system as a continuous beam on elastic supports. In this case the calculation of the horizontal forces at the tops of the piles present a problem similar to that of

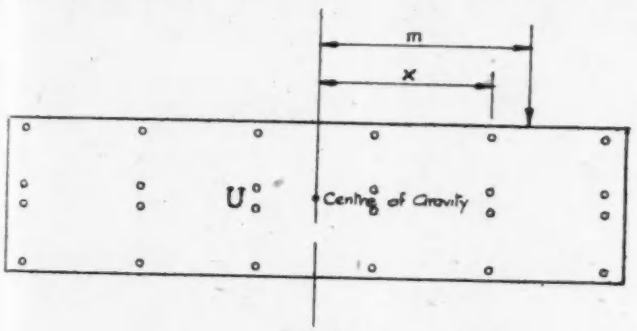


Fig. 4.

combined thrust and bending. The conditions are illustrated in Fig. 4., where :—

P=impact force.
U=the unit of one pile bent.
n=the number of pile bents.

The horizontal force per pile bent is :

$$H_x=\frac{P}{n}+\frac{Pmx}{\Sigma x^2} \quad (18)$$

The calculation of the distributive effect of the super structure can be made without knowing the value of the impact force as it depends on the relative stiffness of the supports and the super structure. The first step in the calculation of the impact stresses is therefore to determine whether the system is that illustrated by Figs. 1 and 2 or that illustrated by Fig. 4. The next step is to calculate the kinetic energy transferred to the system in accordance with the assumptions set out in the preceding and resulting in equations (16) and (17). Then follows the calculation of the impact force from equation (4) :—

$$P=\frac{2A}{Y_p} \text{ which can be written as : } P=\frac{\sqrt{2A}}{\sqrt{Y'_p}} \quad (5)$$

where as previously A is the kinetic energy transferred to the system and Y'_p the deflection of the system at the point of impact per unit of force.

The procedure of calculation is thus when the system is as shown on Figs. 1 and 2 :—

(1) The horizontal deflection of the pile bents are calculated per unit of force, i.e., K in equation (9) is determined.
(2) The coefficients e, a and b are calculated by equation (9).
(3) The deflection Y'_p at the point of impact is calculated per unit of force acting at this point.

If the point of impact is in front of a pile bent the deflection is :

(a) intermediate pile bents : $Y'_p=R\,\frac{a+0.33}{ab}$

(b) pile bents at ends : $Y'_p=K\,\frac{2b}{1+a+b}$

(4) The impact force is calculated by equation (5) : $P=\frac{\sqrt{2A}}{\sqrt{Y'_p}}$
(5) The reactions and bending moments are calculated by equations (6), (7), (10), (11) and (12) as the case may be.
(6) The stresses in the deck and the pile loads are calculated in the usual manner.

When the system is that shown in Fig. 4 the calculation proceeds as follows :—

(1) as (1) above.
(2) as (2) above.
(3) The deflection Y'_p at the point of impact is calculated per unit of force acting at this point.

If the point of impact is in front of a pile bent the deflection is :

$$Y'_p=K\left(\frac{1}{n}+\frac{mx}{\Sigma x^2}\right)$$

and if the point of impact is half way between two pile bents : (r) and (r+1) :

$$Y'_p=K\left(\frac{1}{n}+\frac{X_r+X_{r+1}}{2\Sigma X^2}m\right)$$

(4) as (4) above.
(5) The pile loads are calculated, and the bending moments and resulting stresses in the deck may also be calculated ; but will generally be found insignificant due to the great stiffness of the deck as a horizontal girder.

The Y'_p calculated in accordance with the preceding is the deflection of the point of impact resulting from the deflection of the pile bents of the structure proper and of the deck of this. When an elastic deformation of the fenderwork also takes place this has to be added to the deflection of the structure proper for the calculation of the impact force.

The elastic deformation of the fendering if fixed solidly to the structure proper is very small. The crushing strength of timber is on an average 2,000 lbs. per sq. in. and the corresponding compression 0.015 in. per ft. thickness of timber. This means that fendering of this type is merely a protection to the surface of the structure proper and does not reduce the impact force appreciably.

The elastic deformation of fendering fixed at points only, on the other hand, may be considerable and thus serves to reduce the impact forces. The importance of this function of the fenders will be illustrated by the example at the end of this analysis.

The piles are further to some extent elastically held in the sea bottom, which also contributes to the elastic deformation of the system. R. R. Minikin has dealt very fully with this aspect of the

Impact Stresses in Jetties, Wharves and Similar Structures—continued

problem in his paper in the *Structural Engineer*, August, 1943, and in his article in the *Dock and Harbour Authority*, January, 1945. It is, however, the writer's opinion that this contribution to the deflection depends entirely on local ground conditions, is by far the most important in the case of structures containing vertical piles only and further is likely to decrease in time when the structure has been exposed to a number of impacts and the permanent deformation has increased, and that therefore it is not to be taken into consideration in a general analysis. This omission is also justified by the fact that it errs on the side of safety.

The elastic deformation of the pile bents depends upon the arrangement of the piles. The pile bents may contain :

(*a*) Vertical piles only.
(*b*) Vertical and raking piles.
(*c*) Raking piles only.

The first of these types varies from the two others in that it depends upon the piles being fixed either in the ground or in the super structure or at both places for its capacity to resist horizontal forces, and these will cause bending in the piles, whereas pile groups of types (*f*) and (*c*) can resist horizontal forces without other than axial loads in the piles being caused.

The deflection of the tops of the piles are calculated as follows:—

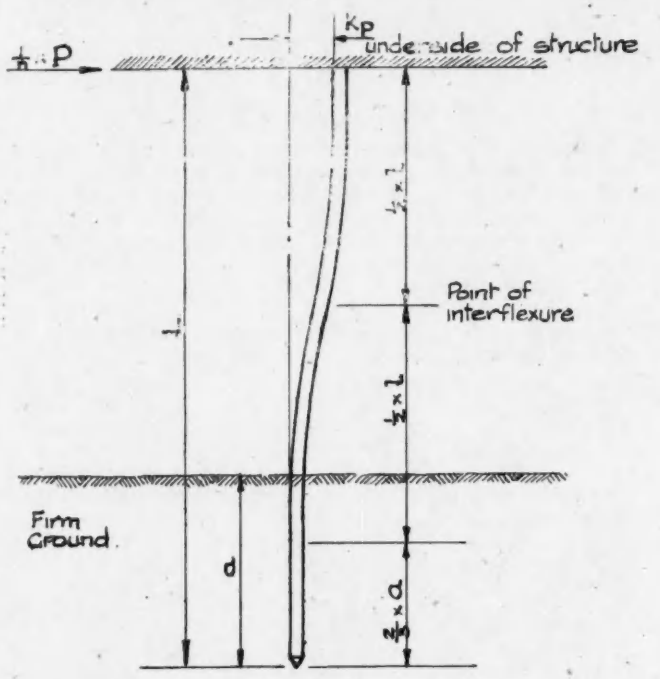


Fig. 5.

Pile bents with vertical piles only.

Fig. 5 illustrated the conditions obtaining when the piles are fixed both top and bottom but free to move horizontally at the top. The deflection is :

$$K=\frac{Pl^3}{n6EI} \text{ inches} \quad (19)$$

where :

P = horizontal force acting on pile bent in lbs.
l = free length of pile in inches.
n = number of piles in pile bent.
E = modulus of elasticity of pile material in lbs. per sq. in.
I = moment of inertia of pile in inch⁴.

Pile bents with both vertical and raking piles or with raking piles only.

The calculation of stresses and deformations of pile groups of these types has been shown in an article by the writer appearing in the *Dock and Harbour Authority*, May, June and July, 1944. Fig. 6 is reproduced from this article and the following formulæ are derived therein for the pile loads :

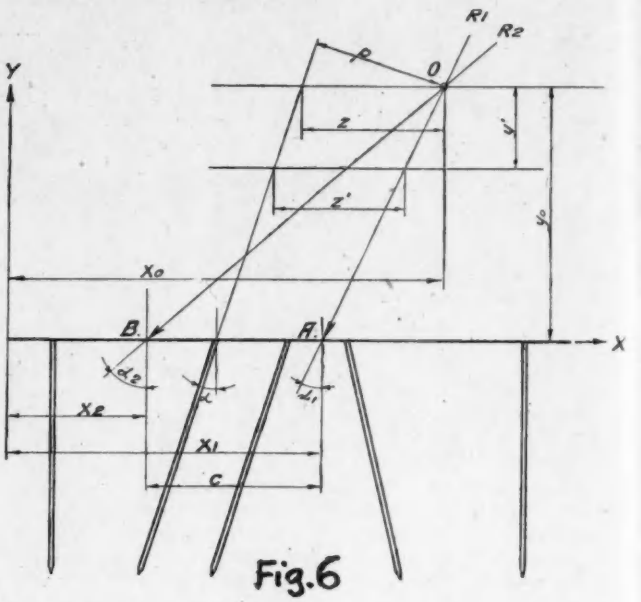


Fig. 6

General case :

$$P=\frac{1}{\cos\alpha}\left[\frac{Lv}{\Sigma v}\times\frac{\tan\alpha_2-\tan\alpha}{\tan\alpha_2-\tan\alpha_1}+\frac{Hv}{\Sigma v\tan^2\alpha}\times\frac{\tan\alpha-\tan\alpha_2}{\tan\alpha_2-\tan\alpha_1}+\frac{MvZ}{I}\right] \quad (20)$$

Symmetrical pile groups :

$$P=\frac{1}{\cos\alpha}\left[\frac{Lv}{\Sigma v}+\frac{Hv\tan\alpha}{\Sigma v\tan^2\alpha}+\frac{MvZ}{I}\right] \quad (21)$$

where :

$$v=\frac{EA}{S}\cos^2\alpha\ ;\ \tan\alpha_1=\frac{\Sigma v\tan\alpha}{\Sigma v}\ ;\ \tan\alpha_2=\frac{\Sigma v\tan^2\alpha}{\Sigma v\tan\alpha}$$

$X_0=X_1+Y_0\tan\alpha_1=X_2+Y_0\tan\alpha_2$
L = vertical component of forces.
H = horizontal component of forces.
M = moment of forces with regard to the 0-point.
$I=\Sigma vZ^2$
and the 0-point is the point in regard to which I is a minimum.

In the special case of a symmetrical pile group the 0-point is located in the axis of symmetry and $\tan\alpha_1=0$ and $\tan\alpha_2=\infty$. If further all the raking piles on one side of the axis of symmetry are parallel $Y_0\times\frac{Xa}{\tan\alpha}$ where Xa is the distance from the line of symmetry to the centre of gravity of the raking piles on one side of this.

In the case under examination $L=0$, $M=H\times Y_0$ and accordingly :—

$$P=\frac{Hv}{\cos\alpha}\left[\frac{1}{\Sigma v\tan^2\alpha}\times\frac{\tan\alpha-\tan\alpha_1}{\tan\alpha_2-\tan\alpha_1}+\frac{Y_0Z}{I}\right] \quad (22)$$

and in the special case of symmetrical pile groups :

$$P=\frac{Hv}{\cos\alpha}\left[\frac{\tan\alpha}{\Sigma v\tan^2\alpha}+\frac{Y_0Z}{I}\right] \quad (23) \text{ and}$$

$$P=\frac{HvY_0Z}{I} \quad (24)$$

for the raking piles and the vertical piles respectively.

The turning of the system round the 0-point is determined by :

$$\phi=\frac{M}{I}=\frac{HY_0}{I}$$

Impact Stresses in Jetties, Wharves and Similar Structures—continued

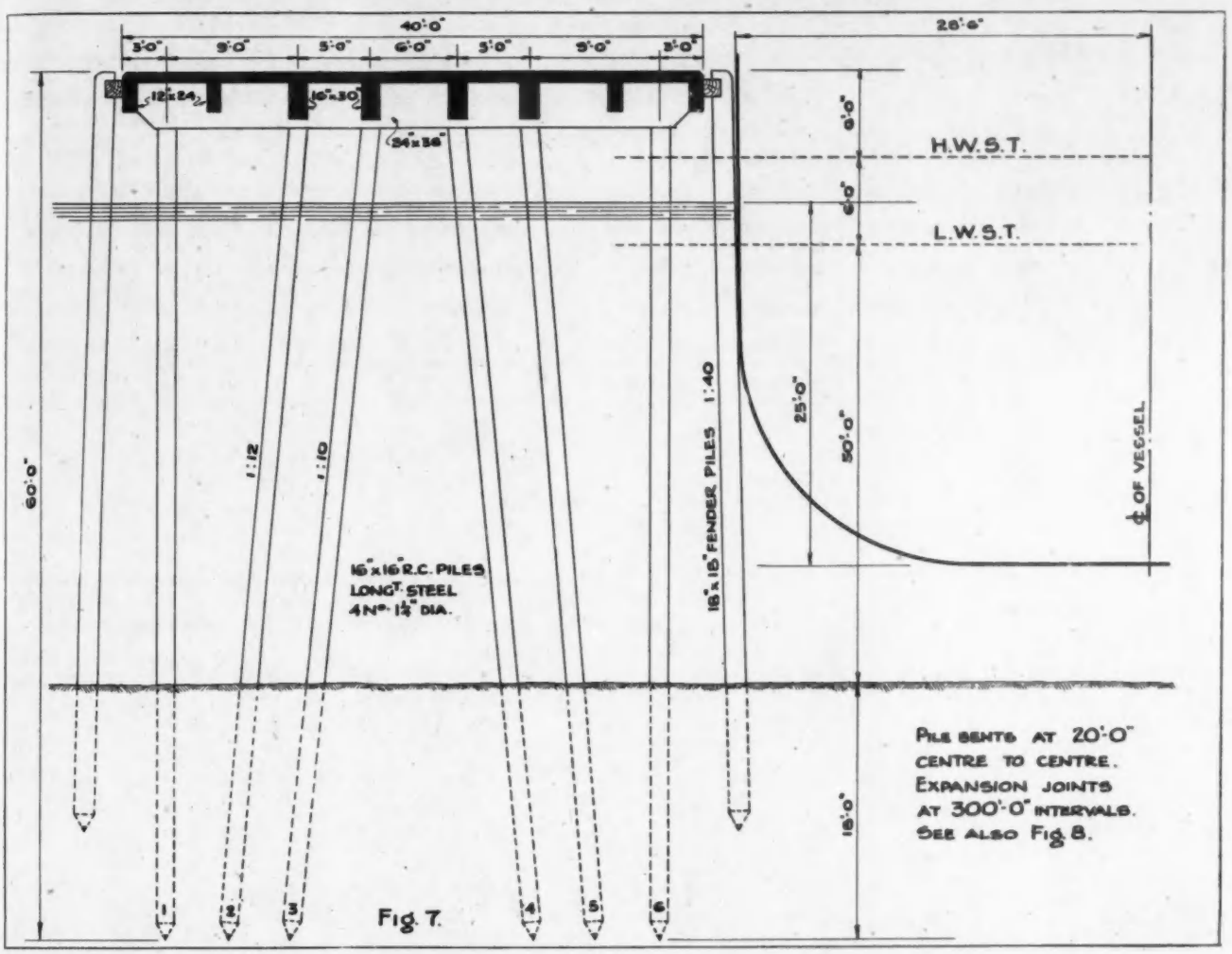


Fig. 7.

and the horizontal movement at the top of the piles is :

$$k_H = Y_0 \varnothing = \frac{HY_0^2}{I} \text{ and per unit of force : } k = \frac{Y_0^2}{I} \qquad (25)$$

The preceding gives the basis both for calculation of impact force and pile loads.

The application of the analysis will now be illustrated by an example.

Example.

A vessel of 5500 reg. tons, 500 ft. long, 57 ft. broad and with 25 ft. draft loaded is berthing at a jetty with the cross section shown in Fig. 7. The vessel is approaching the jetty at an angle of 20° at a speed of 1½ knots. The speed after the first contact with the jetty is practically nil.

The displacement of the vessel is in accordance with equation (13).

$$w = 0.75 \times \frac{500 \times 57 \times 25}{35} = 15250 \text{ tons.}$$

The velocity of the vessel is : 1.5 knot $= \frac{1.5 \times 6080}{60 \times 60} = 2.5$ ft. per sec.

The kinetic energy transferred to the structure is according to equation (16).

$$A = 0.003 \times 15250 \times (2.5 \sin 20°)^2 = 33.4 \text{ ft. ton.}$$

The characteristics of the structure are shown in Fig. 7, and its statistical coefficients are calculated in Table I and below.

Moment of inertia of deck (horizontal).

$I = \frac{1}{12} \times 9 \times 480^3 = 82944000 \text{ in}^4$
$2 \times 12 \times 24 \times 234^2 = 31540000 \text{ in}^4$
$2 \times 12 \times 24 \times 165^2 = 15680000 \text{ in}^4$
$2 \times 16 \times 30 \times 96^2 = 8860000 \text{ in}^4$
$2 \times 16 \times 30 \times 36^2 = 1246000 \text{ in}^4$
140270000 in^4

Cross section of piles :

$A = 16 \times 16 + 15 \times 4 \times 1.227 = 330 \text{ in}^2$

Free length of piles :

$s = (38.25 + \frac{1}{3} \times 18.00) \times 12 = 531 \text{ in.}$

Modulus of elasticity for piles :

$E \times 2000000 \text{ lbs./in}^2 = 893 \text{ tons/in}^2$

and in accordance with the notations to equations (20) and (21) :

$$v = \frac{EA \cos^2 \alpha}{s} = 555 \cos^2 \alpha \text{ tons/in.}$$

The 0-point is determined as the point in regard to which $I = \Sigma v Z^2$ is the least possible. As the contribution to I of piles 1 and 6 is constant they can be left out of consideration in calculating the position of the 0-point. Similarly as $\frac{EA}{s}$ = Constant we may leave this constant out in calculating the v.s. Let Y be the height of the 0-point above the pile tops then :—

Impact Stresses in Jetties, Wharves and Similar Structures—continued

TABLE I.

PILE No.	TAN α	$\frac{1}{\cos\alpha}$	$\cos^2\alpha$	$\sin^2\alpha$	$\cos\alpha \times \sin\alpha$	Z	$Z^2 \times \cos^2\alpha$	$Z \times \cos\alpha$
1	0	1.0000	1.0000	0.	0	17.00	289.0	+17.00
2	0.0833	1.0050	0.9890	0.0110	0.0824	3.17	9.9	+ 3.14
3	0.1000	1.0035	0.9930	0.0070	0.0993	- 2.80	7.8	- 2.78
4	- 0.1000	1.0035	0.9930	0.0070	- 0.0993	+ 2.80	7.8	+ 2.78
5	- 0.0833	1.0050	0.9890	0.0110	- 0.0824	- 3.17	9.9	- 3.14
6	0	1.0000	1.0000	0	0	- 17.00	289.0	- 17.00
SUM			5.9640	0.0360			613.4	

$$i=0.989(8.00-\frac{Y}{12})^2+0.993\times(3.00-\frac{Y}{10})^2$$
$$=0.0158Y^2-1.832Y+72.233$$
$$\frac{di}{dy}=0.0316Y-1.832=0 \quad Y=58.00 \text{ ft.}$$

and :

$$Z_2=8.00-\frac{58}{12}=3.17\ ;\ Z_3=3.00-\frac{58}{10}=-2.80$$

For a horizontal force 1 the pile loads are then in accordance with equations (23) and (24) :

$$P_1=\frac{1.00\times1.0000\times58.00\times17.00}{613.4}=1.61 \quad P_6=-1.61$$
$$P_2=\frac{1.00\times0.989}{0.995}\times\left[\frac{0.0833}{0.0360}+\frac{58.00\times3.17}{613.4}\right]=2.60$$
$$P_3=\frac{1.00\times0.993}{0.997}\times\left[\frac{0.1000}{0.0360}-\frac{58.00\times2.80}{613.4}\right]=2.51$$
$$P_4=-P_3=-2.51 \quad P_5=-P_2=-2.60$$

and the horizontal movement at the top of the piles is according to equation (25) :

$$k=\frac{(58\times12)^2}{555\times613.4}=1.425 \text{ in. per ton.}$$

The next step in the calculation is to examine whether the system is that shown in Fig. 2 or that shown in Fig. 4. If it is that shown in Fig. 2, then in accordance with equations (9) :

$$e=\frac{6EIK}{l^3}=\frac{6\times2000000\times140270000\times1.425}{(20\times12)^3\times2240}$$
$$=77500 \text{ where E has been entered in inches per lb.}$$

Equations (9) give further :

$$a=\frac{\sqrt{1+8e}}{\sqrt{3}}=445 \quad \text{and } b=\frac{\sqrt{4+2a}}{\sqrt{3}}=17.5$$

from which :

$$R_r=\frac{(a+\frac{1}{2})P}{ab}=\frac{P}{175}+\frac{P}{3\times455\times175}$$

i.e. the deck is so stiff that it must be considered infinitely rigid in regard to the pile bents and the system is that shown in Fig. 4 of which particulars are given in Fig. 8. Referring to equation (18) we have :

$$n=16 \quad m=130 \quad \Sigma x^2=134516$$
$$\text{max. } H=\left(\frac{1}{16}+\frac{130\times147.5}{134516}\right)\times P=0.205\times P$$

and :

$$Y'_p=k\left(\frac{1}{16}+\frac{130\times130}{134516}\right)=0.22 \text{ in. per ton}$$

from which the impact force is calculated according to equation (5) :

$$P=\frac{\sqrt{2A}}{\sqrt{Y'_p}}=\frac{\sqrt{2\times33.4\times12}}{\sqrt{0.22}}=60 \text{ tons.}$$

and the maximum reaction on one pile bent

$$\text{max. } H=0.205\times60=12.3 \text{ tons.}$$

The resulting loads in the pile are :

$\triangle P_1=1.61\times12.3=20$ tons. $\triangle P_6=-20$ tons.
$\triangle P_2=2.60\times12.3=32$ tons. $\triangle P_5=-32$ tons.
$\triangle P_3=2.51\times12.3=31$ tons. $\triangle P_4=-31$ tons.

It may be assumed that the piles (16″×16″) are supporting a maximum load of 65 tons per pile caused by the weight of the super

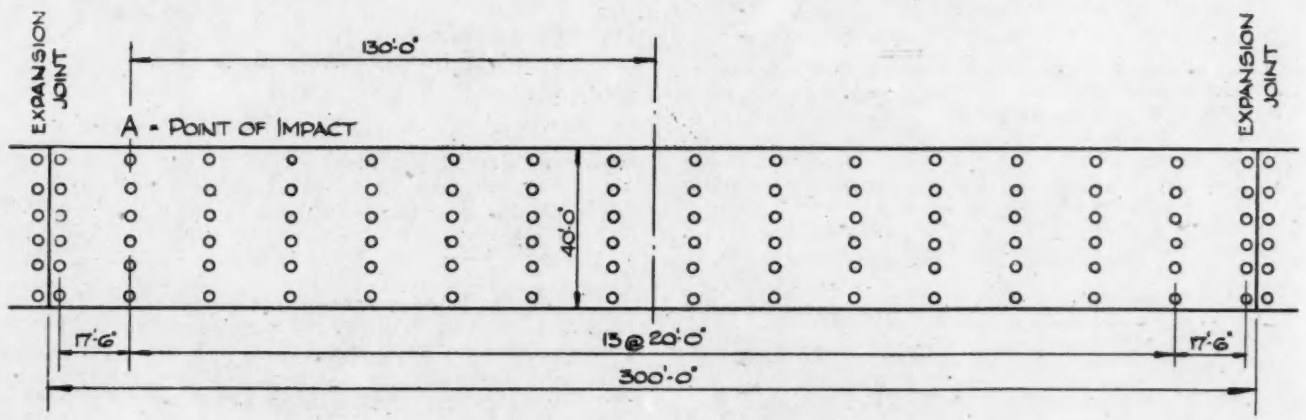


Fig. 8.

Impact Stresses in Jetties, Wharves and Similar Structures—continued

structure and the surcharge on this, and that they are driven to carry this load with a coefficient of safety of at least 3. The additional loads from the impact will reduce the coefficient of safety to just over 2 which must be considered adequate for loads of this nature. In this connection it is to be remembered that the cushioning effect of the fender pile has not been taken into consideration at all. The piles are driven with such a rake that they can bend 6″ on a span of 45 ft. before the impact is transferred directly to the structure proper. To bend the piles 6″ a force of p tons is required determined by :

$$Y=\frac{1}{48}\times\frac{pl^3}{EI}$$

where :

Y=deflection	=6 in.
l =span=45 ft.	=540 in.
E=modulus of elasticity	=670 t/in²
I =moment of inertia	
$=\frac{1}{12}\times d^4=\frac{1}{12}\times 18^4$	= 8748 in⁴

and accordingly :

$$p=\frac{48\times 670\times 8748\times 6}{540^3} \qquad =10.7 \text{ tons,}$$

and the kinetic energy absorbed by the pile has been

$$\frac{1}{2}\times 10.7\times 0.5=2.9 \text{ ft. ton}$$

by which amount it would be permissible to reduce the kinetic energy transferred to the structure proper. The stress caused in the pile is :

$$f=\frac{\frac{1}{4}\times 10.7\times 2240\times 540}{\frac{1}{6}\times 18^3} \qquad =3300 \text{ lbs. per in}^2.$$

which is less than the breaking strength of good timber.

Conclusion.

The writer hopes that the preceding analysis may be of assistance to the engineer concerned with the design or construction of jetties, wharves or similar structures where fill behind the structure cannot be relied upon to absorb the kinetic energy of a vessel coming into contact with the structure at some speed. It is fully realised that the basic assumption for the analysis, viz., that the kinetic energy transferred to the structure is from 20 to 30 per cent. of the vessel's kinetic energy at the time of impact, is open to question. It is, however, suggested for application until such time that research has either confirmed or disproved it—and in the meantime the individual designer may use such factor of safety as he may consider appropriate.

It is further the writer's hope that authorities having the facilities and opportunities for making the fairly simple observations and calculations for a more accurate valuation of the energy absorbed by the structure will make such research and publish the results in the general interest.

New Admiralty Floating Dock at Durban

Completion Ceremony

The following account of the final proceedings in connection with the construction of a 17,000-ton floating dock at Durban, Natal, for the Admiralty is extracted from a recent issue of *Lloyd's List*. The occasion was a luncheon given by the contractors, Dorman, Long (Africa), Ltd., to a number of naval, military and civil guests to see Lady Burnett, wife of Vice-Admiral Sir Robert Burnett, Commander-in-Chief, South Atlantic, drive the last rivet.

Before the final rivet had been driven home, **Sir Robert Burnett,** addressing the company, said that the dock would go out, and wherever it might go, like the people of South Africa who had so generously rested and comforted our men and sent them back again fit for the work they had to do, the dock would take up our ships when they were tired, rest them and make them fit for work again. As a sailor, the Commander-in-Chief thought that one of the greatest contributions which South Africa had made to the war effort was the repair of ships effected in Durban and in other parts of the Union.

Mr. J. M. Osborne, deputy-chairman of Dorman, Long (Africa), Ltd., said that the construction of the dock was a large job, new to South Africa, and it had been built entirely by South African engineers and South African labour. Throughout the construction of the dock he and his firm had received the greatest co-operation from the naval authorities and the Minister of Railways. He also thanked the engineering trade unions, who had done all they could to facilitate not only the construction of the dock but other work of national importance which had been carried out by the firm during the war. The workers, too, had co-operated very closely and were a big factor in the success of the dock.

Constructional Details.

As no slipway was available in South Africa for the launching of so large a structure, the Railway Administration undertook to provide a special erection basin, which was subsequently built by the harbour engineer in Durban. This basin was enclosed by a large cofferdam built at the head of Durban Bay, and its construction presented several civil engineering problems which were successfully overcome by the technical officers of the Administration. The floor is approximately 9-ft. below L.W.O.S.T., and the excavation was kept dry by pumping until the dock itself was virtually complete.

The new dock is much the largest ever constructed in South Africa, and the entire hull, which weighs about 7,000 tons, was fabricated in the contractors' workshops in Durban. The first plate was laid down in September, 1943, since when an army of South African workers has been employed on task of building the dock. This involved assembling over 7,000 tons of steelwork and driving over a millions rivets. The caulking and electrical welding performed ran into many miles. To compensate for the shortage of trained man-power, the contractors successfully undertook the training of a large number of emergency workers, without whose services the maximum rate of progress in fabrication and assembly could not have been maintained.

The process of lifting a 15,000-ton ship can be performed by the dock in the short time of 3½ hours. The dock is a self-contained unit and has its own electrical power station containing Diesel-electric alternators for operating the pumps, lighting and all auxiliary plant such as air compressors, welding machines and the fitting shop. Extensive accommodation and amenities are provided for officers, crew and dock workers. The pumps and valves are operated by push-buttons from a control room on the top of the side wall on the starboard bow. A 30-ton Admiralty floating crane is moored in the cofferdam at the bow of the dock and is a notable example of all-welded steel construction. It weighs about 400 tons, and not a single rivet or bolt was used. The crane was prefabricated by the St. Louis Shipbuilding Company, United States, and assembled by Dorman, Long (Africa) Ltd., simultaneously with the construction of the floating dock.

Clyde Navigation Trust Finances.

The revenue of the Clyde Navigation Trust for the year ended June 30th, 1945, was £1,339,799, the second highest on record, having been exceeded only by the previous year's total. This was disclosed by Mr. J. A. Ralston Mitchell, convener of the finance committee, at a meeting of the trustees in Glasgow on September 4th, when for the first time since the outbreak of war the annual accounts were made public. Deducting expenditure of £1,299,758, the accounts showed a credit balance of £40,041.

Submitting the accounts for approval, Mr. Mitchell said that although victory in Europe came on May 5th last work in the harbour had been carried on throughout the year under war conditions and difficulties. The satisfactory result obtained was in no small degree due to the officials' devotion to duty and their interest in the welfare of the Trust.

Speaking of the prospects for the current year Mr. Mitchell said they must look for a reduced revenue. On the other hand, they were expecting a saving of about £33,000 in air-raid precautions.

The Turbulence of Sea Water

Spin and Noise in Breaking Waves and Obstructed Currents

By HERBERT CHATLEY, D.Sc. (Eng.), M.I.C.E.

The subject of noise in breaking sea waves and the "music" of the surf on the sea-shore may seem remote from the cares of the harbour engineer. When, however, it is considered that the roar of the breaking wave, the rattle of the pebbles on the beach, the smack of the wave against the breakwater, the rushing noise of water passing through a sluice, etc., are all indicative of the degree to which energy is being reduced to futility and express the efficiency or otherwise of the particular device to stem, kill or transmit freely the fluid masses, some excuse may be made for the said engineer to listen, and perhaps draw some useful conclusions. On the academic side it may be said that in the sound there is a hydrodynamic meaning, which at the very least is worth examining.

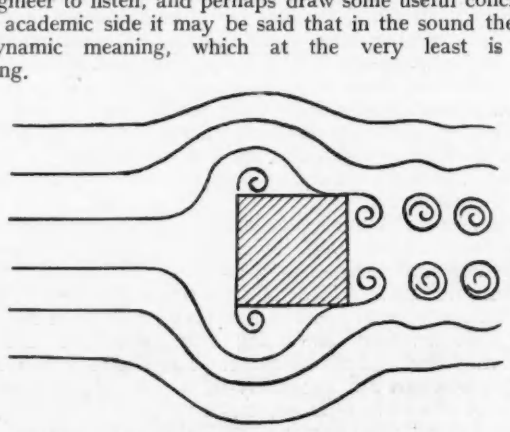


Diagram of eddies produced in flowing water encountering an obstacle.

A rather unexplored field in practical hydrodynamics is the behaviour of eddies and their relations to noises produced by moving water. In all kinds of mechanical engineering great importance is attached to noises and some form of stethoscope is a very useful instrument in the hands of an engineer dealing with running machinery. In civil engineering, apart from the more fearful sounds of cracking and rending and the testing of materials by their "ring," not much notice is taken of noises and yet the sound made by moving air or water is the most obvious index to its behaviour.

Adaptation of Mathematical Theory of Non-Turbulence

Mathematical theory is almost impotent in dealing with turbulent movement of fluids, but there are certain broad mechanical principles which enable the very useful mathematical theory of non-turbulent flow to be empirically supplemented, modified and adapted to turbulent conditions. These principles may be roughly summarised as follows:—

(1) Turbulent flows always involves the "solid" rotation or spin of certain parts of the water. (Eddies or Vortices.)

(2) This spin is produced above certain critical velocities at contact surfaces between the moving fluid and solid boundaries or at the lateral contact of two streams of fluid with different velocities, but most noticeably at points where there are abrupt changes of boundary.

(3) The "drag"-work done at such places is measured by the drag resistance times the relative velocity and this work is almost **wholly** converted into kinetic energy of rotation or spin of the eddies.

(4) Such rotation **can never be re-converted** to simple translational flow and ultimately resolves itself into molecular rotation or oscillation (i.e., heat) and is so lost.

(5) There are very definite limits in each case to the size and peripheral velocity of eddies and therefore to the kinetic energy of rotation in each eddy.

(6) If the eddies are produced at frequencies between 20 and 20,000 per second, they will cause oscillation of the fluids and solids nearby which, if they can reach the air, will be recognised as sounds.

(7) Eddies are generally produced in pairs of contrary rotation or (behind "solids of revolution") in rings of zero external angular momentum.

To give a simple idea of the general problem consider the case of a long square rod 1-ft. wide which is moved through still sea water at a speed of 20-ft. per second in a direction perpendicular to one face. Each foot of its length sweeps out a volume of 20 cub. ft. of sea water per second which weighs 1,280 lbs. or 40 units of mass. This mass is given a velocity varying from zero to 20-ft. per second (or, say, 10-ft. per second), so that the momentum generated per second is, say, 400 lbs. This force acts through 20-ft. during a second so that the work done per second is 8,000 ft. lbs. The water pushed forwards and aside eventually comes back into the same place (or a little ahead) after the rod has passed, but in doing so each particle describes an orbit and most of the water spins at the corners of the rod forming two pairs of eddies. (See diagram). If these eddies are considered to be cylinders of water revolving as solids of diameter equal to, say, half the width of the rod and with peripheral velocity equal to that of the rod through the still water, the kinetic energy in such cylinder can be found and by dividing this into the work done in overcoming the resistance, the maximum *number of cylinders produced per second is known*.

The kinetic energy of a cylindrical mass of sea water of diameter s ft. and surface velocity v ft. per second and 1-ft. length is $\frac{\pi}{10} v^2 s^2$ ft. lb. If s is taken as half-a-foot, this equals in the above case about 140-ft. lbs. and as there are four of the cylindrical masses of water, the total is 160-ft. lbs., so that, dividing into 8,000, there are 50 produced per second (if the eddies are smaller, there will be more of them per second).

If this over-simplified statement correctly represented the conditions, the rod and the air in contact with it would be vibrated 50 times per second and there would be produced a deep musical note with this frequency.

Conditions are not so simple as this, but this gives the general idea. In actual fact, eddies at the rear of the obstacle come off alternately at the two rear corners and there are subordinate eddies; some energy is contained in a pressure wave which travels ahead of the rod; there is some translational kinetic energy in the wake, etc. The frequency is therefore less than 50.

Then again there are other effects to be considered when studying sounds in water. This discontinuous, or uneven, impact of a stream on a solid obstacle tends to create an oscillation in it, the frequency of which depends on its size, shape and elasticity. Bubbles may be produced at audio frequency, air may escape in jets causing air-eddies with audio frequency, loose material in the sea bead may move about with audio frequency or by collisions cause such vibrations in individual pieces and so on, and water running fast in narrow irregular channels will generate streams of eddies with audio frequency.

A high speed projectile passing through the air generates a bow pressure wave, but the main noise is due to series of vortex (eddy) rings produced behind it by the return of the displaced air. In general the frequency of the eddy formation and therefore of the sound varies as the relative speed of the solid to the fluid and inversely as the diameter of the solid so that the high shriek of a shell arises from its high velocity and is lower for large shells than for small ones. The whine, or crescendo and decrescendo, is due to the Doeppler effect which changes the heard frequency according to the relation of the speed of the object with regard to the observer to the speed of sound.

With suitable modifications the same sort of thing must occur with projectiles in water.

The noisy rush of water in full pipes is similarly due to eddies, but the case of pipes at discharge points, etc., is complicated by bubbles, which may come off at a rate which produces a sound.

Physicists when studying sound phenomena have instruments and means by which a complex "noise" can be resolved into a spectrum in which the energy is analysed according to frequency, all the major frequencies can be detected and the distribution of sound energy be seen. If, now, high speed cinematograph cameras, or stroboscopes, are used at these principal frequencies, the actual formation of eddies and the whole physical constitution of the wave, jet, stream or the like should become visible. The technique will, doubtless, be complex, but not insuperably difficult.

Strouhal, Karman, Richardson and others have investigated "æolian" tones and the spacing of eddies in "wakes" and there is a good deal of scattered information on this matter which needs collation.

Thames Lighters and their Functions

An Important River Port Activity

By FRANK C. BOWEN.

The Thames lighter fleet, which numbered between 9,000 and 10,000 craft at the outbreak of war, has been terribly depleted since then, and the problem of replacing the losses and wastage is one which has to be carefully considered for immediate action. Mr. E. O. Stephens, of the Silvertown Services, Ltd., one of the principal lighter-owning firms on the London River, recently started the ball rolling by reading a paper before the Institution of Naval Architects which described the scientific experiments carried out to improve design and construction, particularly for the purpose of securing easier towing without loss of structural strength or carrying capacity. His paper, and the discussion which followed it, showed that the problems are very great and there is a considerable range of opinion on the subject.

London a Barge Port

Very few outside the Port of London fully realise the extent to which it depends on its craft. It has been a barge port from Roman days; the vessel now in the London Museum which was dug up from the foundations of the County Hall is indisputable evidence of that. Punt-shaped "swim-headers," remarkably like the usual lighters of to-day but carrying a single square sail Viking fashion, existed in large numbers in the Middle Ages and made coastal voyages, largely for grain and shipbuilding timber, as well as doing the ordinary lighter work of the port. The concentration of all London's import trade on the Legal Quays on the North side of the Pool under Queen Elizabeth's law created an immense demand for barge service, for most of the ships had to anchor or moor in the stream and lighten their cargoes to the quays. In 1734 it was officially reported that over a thousand barges and lighters were in use in the port, including the East India Company's hoys which carried their cargo from Long Reach up to London until the big ships were sufficiently lightened to work up-river themselves.

Until within living memory the majority of the lighters used tidal power entirely for propulsion—"driving" it was called—with one or two men pulling 25-ft. sweeps to keep them on some sort of a course, although it was such an erratic one that accidents were very frequent. There was no particular hurry and three or four tides from above bridges to the Royal Docks met with no criticism from the owners of the cargoes and craft. The men had to be highly skilled for the navigation of the bridges, old Waterloo Bridge being particularly dangerous. It is still necessary for an apprentice lighterman to prove his ability to drive a barge through the bridges, and the system is still used upstream and for moving between wharves to a certain extent, but towing is almost universal although it still makes great use of the assistance of tidal power.

It is reckoned that well over 50 per cent. of the goods handled by the Port of London in normal times are lightered at one stage or another. The business is constantly being influenced by changing conditions—the reduction in the entrepôt trade was a very serious matter—but it has generally happened that when a section has diminished it has been promptly replaced, at least in part, by a new avenue of activity. There is no doubt that the enormous amount of reconstruction work necessary to repair the bomb damage in London will bring a great deal of work to the barges. The reconstruction of many riverside wharves, the installation of improved facilities in some of the badly-damaged docks, is another opportunity.

Lighter Construction

It is remarkable how little the essential lines of the ordinary swim-headed lighter have been changed in centuries, although changed material and increased size must acquit the builders and owners of any suggestion of lack of enterprise. Although they have many things in their favour, the wooden craft are rapidly disappearing and are not being replaced, for although they were so well built by specialist yards that many of them have had very long lives, the necessary repairs have latterly spoiled their economy. They were splendidly designed for strength and just the right timber was selected for the various parts. A favourite system was Danzig fir for the bottom, English elm for the chines, Sussex oak for the floor, sides and gunwales and pitch pine for the deck and ceiling, but different builders favoured different selections. Many favoured Oregon pine for the bottom, its lengths avoiding any butts.

Experiments have been made from time to time in the use of ship-shaped barges for lighterage purposes; as the running of sailing barges became more difficult a large number were unrigged and towed. They were not as satisfactory as the swim-headed type, which not only handle very easily in a tideway without the stemmed barge's rudder which is always getting smashed in tow, but also avoid a great deal of damage by taking the hard knocks on the specially strengthened swim heads. And in the course of her work the Thames lighter has to sustain an immense amount of knocking about, especially when passing through the locks, when moored in tiers in the open river with passing steamers making a wash and also when they have to take a foul berth.

[Nautical Photo Agency

"Free Water" in the Surrey Commercial; under the old Acts of Parliament, barges have access to the docks on their lawful occasions, free of dues

Iron and Steel Barges

The first experiment with iron barges was made in the 'fifties of last century, but they were not taken seriously until thirty years later, and even then they were exceedingly unpopular with the lightermen. The transition from iron to steel did not come naturally as it did with big ships, but was curiously delayed. Between the two wars a large number of Dutch-built steel barges were acquired by London owners at a price far below anything that the river-side yards could contrive, but many turned out to have been built of German steel which was unfortunately brittle. They were, however, badly needed with the growing trade of the port. After the last war the shortage had to be relieved by the importation of barges of every kind, some built for the Inland Water Docks and Transport Service, keel-shaped barges from the Humber and various others which were not usually associated with the London River and which conclusively proved the advantage of the traditional type for the conditions of the port.

The typical 250-ton steel lighter, a very popular size for general work, is 86-ft. overall by 23-ft. by 9-ft. moulded depth, the hold being about 52-ft. long and closed by non-watertight bulkheads. A few 500-ton lighters and rather more 400-tonners are also doing useful work, but their sphere is restricted to certain cargoes. For important grain business 220 tons is usually the limit; larger than that they will not always go under the spouts of the elevators comfortably.

There are far more specially-designed lighters at work than is usually realised. Meat demands complete insulation and the cost is considerable; sugar, cement and one or two other cargoes are

Thames Lighters and their Functions—continued

particularly sensitive to wet and are dealt with by hatched barges. The petroleum barges, the most strictly controlled on the river, are of very fine design and construction. Dutiable and bonded goods have to have hatches which can be secured by the Customs, the river calls them " locked-down barges. Large timber demands clear holds although a great deal is handled by the small " Surrey Canal " lighters of 120 tons. Many other cargoes call for special attention while coal and other rough cargoes, and many cased goods, employ ordinary open lighters. Any which are fitted with tiny accommodation aft are called " resident lighters."

Lightermen's Organisations

From time immemorial the lighters and their men have been well controlled by the business itself, apart from official regulation. The Lightermen's Company existed for many years alongside, and often in bitter rivalry with, the Watermen's Company until they were forced to combine in order to put a stop to violent disputes. The combined Company is still active, although the men now work under the jurisdiction of the Port of London Authority for whom the Company acts in many things. Between wars there was a great drift of labour away from the sailing barges to the lighters for the sake of better money and easier work, and this undoubtedly accelerated the eclipse of the picturesque sailing barges.

[Nautical Photo Agency

The modern steel lighter is still called an "iron pot" on the River; the angle of the swim ends is carefully calculated for easy towing

The master lightermen have also long believed in a measure of co-operation, although it has not always been smooth. The Barge Owners' Association was established in 1802 for mutual assistance, protection from river pirates, etc., and functioned until 1850. During that period it fought some doughty legal battles on the question of dock dues, wash damage by steamers and many other matters. It was followed by the Committee of Master Lightermen, which had a stormy career until the Association of Master Lightermen and Barge Owners was founded in 1889 and still functions.

Thames Tugs

The growing custom of towing lighters instead of relying on the tides has developed a very finely-organised tug business which still takes full advantage of the " free coal " supplied by nature, practically always towing downstream on the ebb and up on the flood although it is not always possible. The craft tug design has become highly specialised. In the early days any tug which was not sufficiently powerful for serious work was put on to towing craft and innumerable unsuccessful experiments in design, including several of the first screw tugs to be built, were considered good enough provided they could be cheaply acquired. That sort of thing will not do nowadays; it is true that the craft tug can save weight and space in various ways as compared with her seagoing sister, but great ingenuity is necessary to produce a satisfactory and really efficient vessel. A popular type is 75-ft. long with 500 horse-power, and the use of Diesels has become almost universal. For short distance towage of single craft and moving in the docks, heavily-built motor boats are very generally used.

The wastage during the war has been colossal. Many did not come back from Dunkirk. When London was blitzed many were sunk or burned and when trade was diverted to the West to avoid the raids an enormous number were taken away, particularly to the Clyde Anchorages, on the decks of steamers. Scores of the remainder were taken up for conversion into landing craft of various kinds for the invasion of Normandy. Ordinary building in replacement was impossible, but the Government built a number of 200-ton concrete barges which were hired out to lightermen; not being of the traditional London type they are not popular. Certain firms were licensed to build 400-ton barges on a new system with concrete panels in a steel framework which were much more successful.

From time to time for a good many years past, enthusiasts have brought up the question of making the Thames lighters self-propelling, but as only between 5 and 10 per cent. of the average lighter's time is spent under way the idea has always been considered uneconomical and many thought that the lighter's shape would make it impractical. The installation of motors in any number for the Normandy invasion showed that technically it can be done, but there are many questions to be settled before it becomes a general practice, if ever it does.

Many others before Mr. Stephens have paid very careful attention to the possibilities of improving the lighter's towing qualities. It is not an easy problem to solve, for the relative value of capacity and ease of towing depends largely on whether the barges are used for long tows or short and their employment as floating warehouses is another influence. In 1930 the National Physical Laboratory's tank at Teddington was used by the South Metropolitan Gas Company for model experiments, combined with practical towing tests on the river. They did not suggest any very radical alterations in the principles of design, but stream-lining the swim bow and stern, cutting a circular hole in the budget or fixed rudder and other minor features produced a great improvement, claimed to be nearly 40 per cent. reduction in the resistance. Messrs. Harland & Wolff, of North Woolwich, built a number of barges to this design for the South Metropolitan Company, while other owners and builders carried out tank and towing tests, and contrived many improvements, with little publicity.

Publications Received

Mulberry Pier Heads is the title of a brochure, issued by Messrs. Alexander Finlay & Co., Ltd., Parkneuk Works, Motherwell, and descriptive, with a number of effective photographs of the huge steel structures which were built at a speed never before equalled in Britain or America, for the creation of the military harbour at Arromanches on the Normandy Coast, officially known as " Mulberry." Messrs. Alexander Findlay were the parent contractors for the supply of the pierheads which were the major feature of the whole undertaking, in which more than 100 Scottish firms combined to send 30,000 tons of steelwork and machinery to the Normandy harbours.

Mulberry has already been the subject of notice in these columns and it is unnecessary to recapitulate the information already given in our issues of November and December, 1944.

The brochure is an admirable artistic production and its 30 pages contains an excellent resumé of the methods and process of manufacture of the pierheads.

A Triumph of Plastic Armour is an account, issued by the Ministry of Information of a naval scientific production which, having saved lives and steel during the war, is capable of peace-time use for roads and factories Plastic armour consists of a packed mass of stone particles held together by a bituminous mortar and backed by a mild steel plate. The bituminous mortar plays little part in the protection afforded by the armour, beyond holding the stones in position. The account is by Dr. J. P. Lawrie of the Royal Naval Scientific Service.